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Rice Reynolds.

May 28. 1875.

B. U. A. Summer Session

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TEXT-BOOK
OF
WESTERN BOTANY,

CONSISTING OF

COULTER'S MANUAL OF THE BOTANY OF
THE ROCKY MOUNTAINS,

TO WHICH IS PREFIXED

GRAY'S LESSONS IN BOTANY.

FOR THE USE OF SCHOOLS AND COLLEGES BETWEEN THE MISSISSIPPI
RIVER AND THE ROCKY MOUNTAINS.



NEW YORK ··· CINCINNATI ··· CHICAGO
AMERICAN BOOK COMPANY

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Printed by
William Ivison
New York, U. S. A.

PUBLISHERS' NOTE.

THE issue of Professor COULTER'S Botany of the Rocky Mountains, and of the Great Plains between them and the Mississippi Valley, now for the first time brings this great and increasingly populous district, from Dakota and Montana to New Mexico, within the pale of botanical instruction.

To meet the wants of the institutions of learning, as well as of private students, throughout this vast region of surpassing botanical interest, the publishers have combined into one volume this Rocky Mountain Flora with Gray's Lessons in Botany, as its appropriate introduction, grammar, and lexicon.

GRAY'S LESSONS IN BOTANY

REVISED EDITION

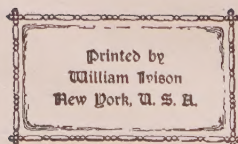
THE
ELEMENTS OF BOTANY

FOR BEGINNERS AND FOR SCHOOLS

By ASA GRAY

NEW YORK ··· CINCINNATI ··· CHICAGO
AMERICAN BOOK COMPANY

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1887.



PREFACE.

THIS volume takes the place of the author's LESSONS IN BOTANY AND VEGETABLE PHYSIOLOGY, published over a quarter of a century ago. It is constructed on the same lines, and is a kind of new and much revised edition of that successful work. While in some respects more extended, it is also more concise and terse than its predecessor. This should the better fit it for its purpose now that competent teachers are common. They may in many cases develop paragraphs into lectures, and fully illustrate points which are barely, but it is hoped clearly, stated. Indeed, even for those without a teacher, it may be that a condensed is better than a diffuse exposition.

The book is adapted to the higher schools, "How Plants Grow and Behave" being the "Botany for Young People and Common Schools." It is intended to ground beginners in Structural Botany and the principles of vegetable life, mainly as concerns Flowering or Phanerogamous plants, with which botanical instruction should always begin; also to be a companion and interpreter to the Manuals and Floras by which the student threads his flowery way to a clear knowledge of the surrounding vegetable creation. Such a book, like a grammar, must needs abound in technical words, which thus arrayed may seem formidable; nevertheless, if rightly apprehended, this treatise should teach that the study of botany is not the learning of names and terms, but the acquisition of knowledge and ideas. No effort should be made to commit technical terms to memory. Any term used in describing a plant or explaining its structure can be looked up when it is wanted, and that should suffice. On the other hand, plans of

structure, types, adaptations, and modifications, once understood, are not readily forgotten ; and they give meaning and interest to the technical terms used in explaining them.

In these "Elements" naturally no mention has been made of certain terms and names which recent cryptogamically-minded botanists, with lack of proportion and just perspective, are endeavoring to introduce into phanerogamous botany, and which are not needed nor appropriate, even in more advanced works, for the adequate recognition of the ascertained analogies and homologies.

As this volume will be the grammar and dictionary to more than one or two Manuals, Floras, etc., the particular directions for procedure which were given in the "First Lessons" are now relegated to those works themselves, which in their new editions will provide the requisite explanations. On the other hand, in view of such extended use, the Glossary at the end of this book has been considerably enlarged. It will be found to include not merely the common terms of botanical description but also many which are unusual or obsolete ; yet any of them may now and then be encountered. Moreover, no small number of the Latin and Greek words which form the whole or part of the commoner specific names are added to this Glossary, some in an Anglicized, others in their Latin form. This may be helpful to students with small Latin and less Greek, in catching the meaning of a botanical name or term.

The illustrations in this volume are largely increased in number. They are mostly from the hand of Isaac Sprague.

It happens that the title chosen for this book is that of the author's earliest publication, in the year 1836, of which copies are rarely seen ; so that no inconvenience is likely to arise from the present use of the name.

ASA GRAY.

CAMBRIDGE, MASSACHUSETTS,
March, 1887.

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ELEMENTS OF BOTANY.

SECTION I. INTRODUCTORY.

1. BOTANY is the name of the science of the vegetable kingdom in general; that is, of plants.

2. Plants may be studied as to their kinds and relationships. This study is SYSTEMATIC BOTANY. An enumeration of the kinds of vegetables, as far as known, classified according to their various degrees of resemblance or difference, constitutes a general *System of plants*. A similar account of the vegetables of any particular country or district is called a *Flora*.

3. Plants may be studied as to their structure and parts. This is STRUCTURAL BOTANY, or ORGANOGRAPHY. The study of the organs or parts of plants in regard to the different forms and different uses which the same kind of organ may assume, — the comparison, for instance, of a flower-leaf or a bud-scale with a common leaf, — is VEGETABLE MORPHOLOGY, or MORPHOLOGICAL BOTANY. The study of the minute structure of the parts, to learn by the microscope what they themselves are formed of, is VEGETABLE ANATOMY, or HISTOLOGY; in other words, it is Microscopical Structural Botany. The study of the actions of plants or of their parts, of the ways in which a plant lives, grows, and acts, is the province of PHYSIOLOGICAL BOTANY, or VEGETABLE PHYSIOLOGY.

4. This book is to teach the outlines of Structural Botany and of the simpler parts of the physiology of plants, that it may be known how plants are constructed and adapted to their surroundings, and how they live, move, propagate, and have their being in an existence no less real, although more simple, than that of the animal creation which they support. Particularly, this book is to teach the principles of the structure and relationships of plants, the nature and names of their parts and their modifications, and so to prepare for the study of Systematic Botany; in which the learner may ascertain the name and the place in the system of any or all of the ordinary plants within reach, whether wild or cultivated. And in ascertaining the name of any plant, the student, if rightly taught, will come to know all about its general or particular structure, rank, and relationship to other plants.

5 The vegetable kingdom is so vast and various, and the difference is so wide between ordinary trees, shrubs, and herbs on the one hand, and mosses, moulds, and such like on the other, that it is hardly possible to frame an intelligible account of plants as a whole without contradictions or misstatements, or endless and troublesome qualifications. If we say that plants come from seeds, bear flowers, and have roots, stems, and leaves, this is not true of the lower orders. It is best for the beginner, therefore, to treat of the higher orders of plants by themselves, without particular reference to the lower.

6. Let it be understood, accordingly, that there is a higher and a lower series of plants; namely:—

PHANEROGAMOUS PLANTS, which come from seed and bear *flowers*, essentially stamens and pistils, through the co-operation of which seed is produced. For shortness, these are commonly called PHANEROGAMS, or *Phenogams*, or by the equivalent English name of FLOWERING PLANTS.¹

CRYPTOGAMOUS PLANTS, or CRYPTOGRAMS, come from minute bodies, which answer to seeds, but are of much simpler structure, and such plants have not stamens and pistils. Therefore they are called in English FLOWERLESS PLANTS. Such are Ferns, Mosses, Algæ or Seaweeds, Fungi, etc. These sorts have each to be studied separately, for each class or order has a plan of its own.

7. But Phanerogamous, or Flowering, Plants are all constructed on one plan, or *type*. That is, taking almost any ordinary herb, shrub, or tree for a pattern, it will exemplify the whole series: the parts of one plant answer to the parts of any other, with only certain differences in particulars. And the occupation and the delight of the scientific botanist is in tracing out this common plan, in detecting the likenesses under all the diversities, and in noting the meaning of these manifold diversities. So the attentive study of any one plant, from its growth out of the seed to the flowering and fruiting state and the production of seed like to that from which the plant grew, would not only give a correct general idea of the structure, growth, and characteristics of Flowering Plants in general, but also serve as a pattern or standard of comparison. Some plants will serve this purpose of a pattern much better than others. A proper pattern will be one that is perfect in the sense of having all the principal parts of a phanerogamous plant, and simple and regular in having these parts free from complications or disguises. The common Flax-plant may very well serve this purpose. Being an annual, it has the advantage of being easily raised and carried in a short time through its circle of existence, from seedling to fruit and seed.

¹ The name is sometimes *Phanerogamous*, sometimes *Phænogamous* (*Phanero-gams*, or *Phænogams*), terms of the same meaning etymologically; the former of preferable form, but the latter shorter. The meaning of such terms is explained in the Glossary.

SECTION II. FLAX AS A PATTERN PLANT.

8. **Growth from the Seed.** Phanerogamous plants grow from seed, and their flowers are destined to the production of seeds. A seed has a rudimentary plant ready formed in it, — sometimes with the two most essential parts, i. e. stem and leaf, plainly discernible; sometimes with no obvious distinction of organs until germination begins. This incipient plant is called an **EMBRYO**.

9. In this section the Flax-plant is taken as a specimen, or type, and the development and history of common plants in general is illustrated by it. In flax-seed the embryo nearly fills the coats, but not quite. There is a small deposit of nourishment between the seed-coat and the embryo: this may for the present be left out of the account. This embryo consists of a pair of leaves, pressed together face to face, and attached to an extremely short stem. (Fig. 2-4.) In this rudimentary condition the real nature of the parts is not at once apparent; but when the seed grows they promptly reveal their character, — as the accompanying figures (Fig. 5-7) show.



10. Before the nature of these parts in the seed was altogether understood, technical names were given to them, which are still in use. These initial leaves were named **COTYLEDONS**. The initial stem on which they stand was called the **RADICLE**. That was because it gives rise to the first root; but, as it is really the beginning of the stem, and because it is the stem that produces the root and not the root that produces the stem, it is better to name it the **CAULICLE**. Recently it has been named *Hypocotyle*; which signifies something below the cotyledons, without pronouncing what its nature is.

FIG. 1. Pod of Flax. 2. Section lengthwise, showing two of the seeds; one whole, the other cut half away, bringing contained embryo into view. 3. Similar section of a flax-seed more magnified and divided flatwise; turned round, so that the stem-end (caulicle) of the embryo is below: the whole broad upper part is the inner face of one of the cotyledons; the minute nick at its base is the plumule. 4. Similar section through a seed turned edgewise, showing the thickness of the cotyledons, and the minute plumule between them, i. e. the minute bud on the upper end of the caulicle.

11. On committing these seeds to moist and warm soil they soon sprout, i. e. *germinate*. The very short stem-part of the embryo is the first to grow. It lengthens, protrudes its root-end; this turns downward, if not already pointing in that direction, and while it is lengthening a root forms at its point and grows downward into the ground. This root continues to grow on from its lower end, and thus insinuates itself and penetrates into the soil. The stem meanwhile is adding to its length throughout; it erects itself, and, seeking the light, brings the seed up out of the ground. The materials for this growth have been supplied by the cotyledons or seed-leaves, still in the seed: it was the store of nourishing material they held which gave them their thickish shape, so unlike that of ordinary leaves. Now, relieved of a part of this store of food, which has formed the growth by which they have been raised into the air and light, they appropriate the remainder to their own growth. In enlarging they open and throw off the seed-husk; they expand, diverge into a horizontal position, turn green, and thus become a pair of evident leaves, the first foliage of a tiny plant. This seedling, although diminutive and most simple, possesses and puts into use, all the ORGANS of VEGETATION, namely, root, stem, and leaves, each in its proper element,—the root in the soil, the stem rising out of it, the leaves in the light and open air. It now draws in moisture and some food-materials from the soil by its root, conveys this through the stem into the leaves, where these materials, along with other crude food which these imbibe from the air, are assimilated into vegetable matter, i. e. into the material for further growth.

12. Further Growth soon proceeds to the formation of new parts,—downward in the production of more root, or of branches of the main root, upward in the development of more stem and leaves. That from which a stem with its leaves is continued, or a new stem (i. e. branch) originated, is a BUD. The most conspicuous and familiar buds are those of most shrubs and trees, bearing buds formed in summer or autumn, to grow the following

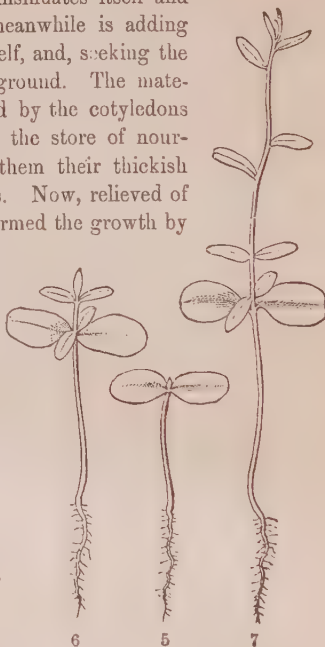


FIG. 5. Early Flax seedling; stem (caulicle), root at lower end, expanded seed-leaves (cotyledons) at the other: minute bud (plumule) between these. 6. Same later; the bud developed into second pair of leaves, with hardly any stem-part below them; then into a third pair of leaves, raised on a short joint of stem; and a fifth leaf also showing. 7. Same still older, with more leaves developed, but these singly (one after another), and with joints of stem between them.

spring. But every such point for new growth may equally bear the name. When there is such a bud between the cotyledons in the seed or seedling it is called the *PLUMULE*. This is conspicuous enough in a bean (Fig. 29.), where the young leaf of the new growth looks like a little plume, whence the name, *plumule*. In flax-seed this is very minute indeed, but is discernible with a magnifier, and in the seedling it shows itself distinctly (Fig. 5, 6, 7).

13. As it grows it shapes itself into a second pair of leaves, which of course rests on a second joint of stem, although in this instance that remains too short to be well seen. Upon its summit appears the third pair of leaves, soon to be raised upon its proper joint of stem; the next leaf is single, and is carried up still further upon its supporting joint of stem; and so on. The root, meanwhile, continues to grow underground, not joint after joint, but continuously, from its lower end; and commonly it before long multiplies itself by branches, which lengthen by the same continuous growth. But stems are built up by a succession of leaf-bearing growths, such as are strongly marked in a reed or corn-stalk, and less so in such an herb as Flax. The word "joint" is ambiguous: it may mean either the portion between successive leaves, or their junction, where the leaves are attached. For precision, therefore, the place where the leaf or leaves are borne is called a *NODE*, and the naked interval between two nodes, an *INTERNODE*.

14. In this way a simple stem with its garniture of leaves is developed from the seed. But besides this direct continuation, buds may form and develop into lateral stems, that is, *into branches*, from any node. The proper origin of branches is from the *AXIL* of a leaf, i. e. the angle between leaf and stem on the upper side; and branches may again branch, so building up the herb, shrub, or tree. But sooner or later, and without long delay in an annual like Flax, instead of this continuance of mere vegetation, reproduction is prepared for by



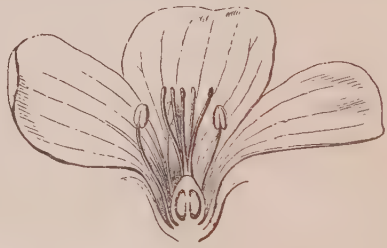
FIG. 8. Upper part of Flax-plant in blossom.

15. **Blossoming.** In Flax the flowers make their appearance at the end of the stem and branches. The growth, which otherwise might continue them farther or indefinitely, now takes the form of blossom, and is subservient to the production of seed.

16. **The Flower** of Flax consists, first, of five small green leaves, crowded into a circle: this is the **CALYX**, or flower-cup. When its separate leaves are referred to they are called **SEPALS**, a name which distinguishes them from foliage-leaves on the one hand, and from petals on the other. Then come five delicate and *colored* leaves (in the Flax, blue), which form the **COROLLA**, and its leaves are **PETALS**; then a circle of organs, in



9



10

which all likeness to leaves is lost, consisting of slender stalks with a knob at summit, the **STAMENS**; and lastly, in the centre, the rounded body, which becomes a pod, surmounted by five slender or stalk-like bodies. This, all together, is the **PISTIL**. The lower part of it, which is to contain the seeds, is the **OVARY**; the slender organs surmounting this are **STYLES**; the knob borne on the apex of each style is a **STIGMA**. Going back to the stamens, these are of two parts, viz. the stalk, called **FILAMENT**, and the body it bears, the **ANTHER**. Anthers are filled with **POLLEN**, a powdery substance made up of minute grains.

17. The pollen shed from the anthers when they open falls upon or is conveyed to the stigmas; then the pollen-grains set up a kind of growth (to be discerned only by aid of a good microscope), which penetrates the style: this growth takes the form of a thread more delicate than the finest spider's web, and reaches the bodies which are to become seeds (**OVULES** they are called until this change occurs); these, touched by this influence, are incited to a new growth within, which becomes an embryo. So, as the ovary ripens into the seed-pod or capsule (Fig. 1, etc.) containing seeds, each seed enclosing a rudimentary new plantlet, the round of this vegetable existence is completed.

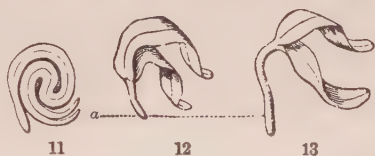
FIG. 9. Flax-flowers about natural size. 10. Section of a flower moderately enlarged, showing a part of the petals and stamens, all five styles, and a section of ovary with two ovules or rudimentary seeds.

SECTION III. MORPHOLOGY OF SEEDLINGS.

18. Having obtained a general idea of the growth and parts of a phanerogamous plant from the common Flax of the field, the seeds and seedlings of other familiar plants may be taken up, and their variations from the assumed pattern examined.

19. **Germinating Maples** are excellent to begin with, the parts being so much larger than in Flax that a common magnifying glass, although convenient, is hardly necessary. The only disadvantage is that fresh seeds are not readily to be had at all seasons.

20. The seeds of Sugar Maple ripen at the end of summer, and germinate in early spring. The embryo fills the whole seed, in which it is nicely packed; and the nature of the parts is obvious even before growth begins. There is a stemlet (caulicle) and a pair of long and narrow seed-leaves (cotyledons), doubled up and coiled, green even in the seed, and in germination at once unfolding into the first pair of foliage-leaves, though of shape quite unlike those that follow.

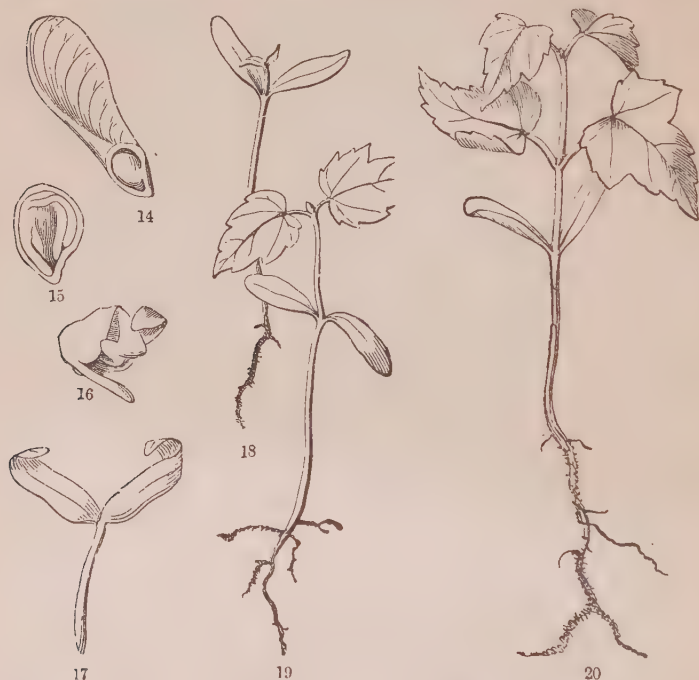


21. Red Maple seeds are ripe and ready to germinate at the beginning of summer, and are therefore more convenient for study. The cotyledons are crumpled in the seed, and not easy to straighten out until they unfold themselves in germination. The story of their development into the seedling is told by the accompanying Fig. 14-20; and that of Sugar Maple is closely similar. No plumule or bud appears in the embryo of these two Maples until the seed-leaves have nearly attained their full growth and are acting as foliage-leaves, and until a root is formed below. There is no great store of nourishment in these thin cotyledons; so further growth has to wait until the root and seed-leaves have collected and elaborated sufficient material for the formation of the second internode and its pair of leaves, which lending their help the third pair is more promptly produced, and so on.

22. Some change in the plan comes with the Silver or Soft White Maple. (Fig. 21-25). This blossoms in earliest spring, and it drops its large and ripened keys only a few weeks later. Its cotyledons have not at all the appearance of leaves; they are short and broad, and (as there is no room to be saved by folding) they are straight, except a small fold at the top, — a vestige of the habit of Maples in general. Their unusual thickness is due

FIG. 11. Embryo of Sugar Maple, cut through lengthwise and taken out of the seed. 12, 13. Whole embryo of same just beginning to grow; *a*, the stemlet or caulicle, which in 13 has considerably lengthened.

to the large store of nutritive matter they contain, and this prevents their developing into actual leaves. Correspondingly, their caulicle does not lengthen to elevate them above the surface of the soil; the growth below the cotyledons is nearly all of root. It is the little plumule or bud between



them which makes the upward growth, and which, being well fed by the cotyledons, rapidly develops the next pair of leaves and raises them upon a long internode, and so on. The cotyledons all the while remain below, in the husk of the fruit and seed, and perish when they have yielded up the store of food which they contained.

23. So, even in plants so much alike as Maples, there is considerable difference in the amount of food stored up in the cotyledons by which the growth is to be made; and there are corresponding differences in the ger-

FIG. 14. One of the pair of keys or winged fruits of Red Maple; the seed-bearing portion cut open to show the seed. 15. Seed enlarged, and divided to show the crumpled embryo which fills it. 16. Embryo taken out and partly opened. 17. Embryo which has unfolded in early stage of germination and begun to grow. 18. Seedling with next joint of stem and leaves apparent; and 19 with these parts full-grown, and bud at apex for further growth. 20. Seedling with another joint of stem and pair of leaves.

mination. The larger the supply to draw upon, the stronger the growth, and the quicker the formation of root below and of stem and leaves above. This deposit of food thickens the cotyledons, and renders them less and less leaf-like in proportion to its amount.

24. Examples of Embryos with thickened Cotyledons.

In the Pumpkin and Squash (Fig. 26, 27), the cotyledons are well supplied with nourishing matter, as their sweet taste demonstrates. Still, they are flat and not very thick. In germination this store is promptly utilized in the development of the caulicle to twenty or thirty times its length in the seed, and to corresponding thickness, in the formation of a cluster of roots at its lower end, and the early production of the incipient plumule; also in their own growth into efficient green leaves. The case of our common Bean (*Phaseolus vulgaris*, Fig. 28-30) is nearly the same, except that the cotyledons

are much more gorged; so that, although carried up into the air and light upon the lengthening caulicle, and there acquiring a green color, they never expand into useful leaves. Instead of this, they nourish into rapid growth the plumule, which is plainly visible in the seed, as a pair of incipient leaves; and these form the first actual foliage.

25. Very similar is the germination of the Beech (Fig. 31-33), except that the caulicle lengthens less, hardly raising the cotyledons out of the ground. Nothing would be gained by elevating them, as they never grow out into efficient leaves; but the joint of stem belonging to the plumule lengthens well, carrying up its pair of real foliage-leaves.

26. It is nearly the same in the Bean of the Old World (*Vicia Faba*, here called Horse Bean and Windsor Bean): the caulicle lengthens very little, does not undertake to elevate the heavy seed, which is left below or

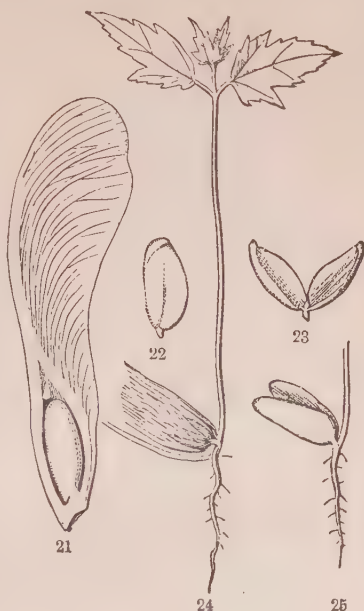


FIG. 21. Fruit (one key) of Silver Maple, *Acer dasycarpum*, of natural size, the seed-bearing portion divided to show the seed. 22. Embryo of the seed taken out. 23. Same opened out, to show the thick cotyledons and the little plumule or bud between them. 24. Germination of Silver Maple, natural size; merely the base of the fruit, containing the seed, is shown. 25. Embryo of same, taken out of the husk; upper part of growing stem cut off, for want of room.

upon the surface of the soil, the flat but thick cotyledons remaining in it, and supplying food for the growth of the root below and the plumule above. In its near relative, the Pea (Fig. 34, 35), this use of cotyledons



for storage only is most completely carried out. For they are thickened to the utmost, even into hemispheres; the caulicle does not lengthen at all; merely sends out roots from the lower end, and develops its strong plumule from the upper, the seed remaining unmoved underground. That is, in technical language, the germination is *hypogæous*.

27. There is sufficient nourishment in the cotyledons of a pea to make a very considerable growth before any actual foliage is required. So it is the stem-portion of the plumule which is at first conspicuous and strong-growing. Here, as seen in Fig. 35, its lower nodes bear each a useless leaf-scale instead of an efficient leaf, and only the later ones bear leaves fitted for foliage.

FIG. 26. Embryo of Pumpkin-seed, partly opened. 27. Young seedling of same.

FIG. 28. Embryo of Common Bean (*Phaseolus vulgaris*): caulicle bent down over edge of cotyledons. 29. Same germinating: caulicle well lengthened and root beginning; thick cotyledons partly spreading; and plumule (pair of leaves) growing between them. 30. Same, older, with plumule developed into internode and pair of leaves.

28. This *hypogæous* germination is exemplified on a larger scale by the Oak (Fig. 36, 37) and Horse-chestnut (Fig. 38, 39); but in these the downward growth is wholly a stout tap-root. It is not the caulicle; for



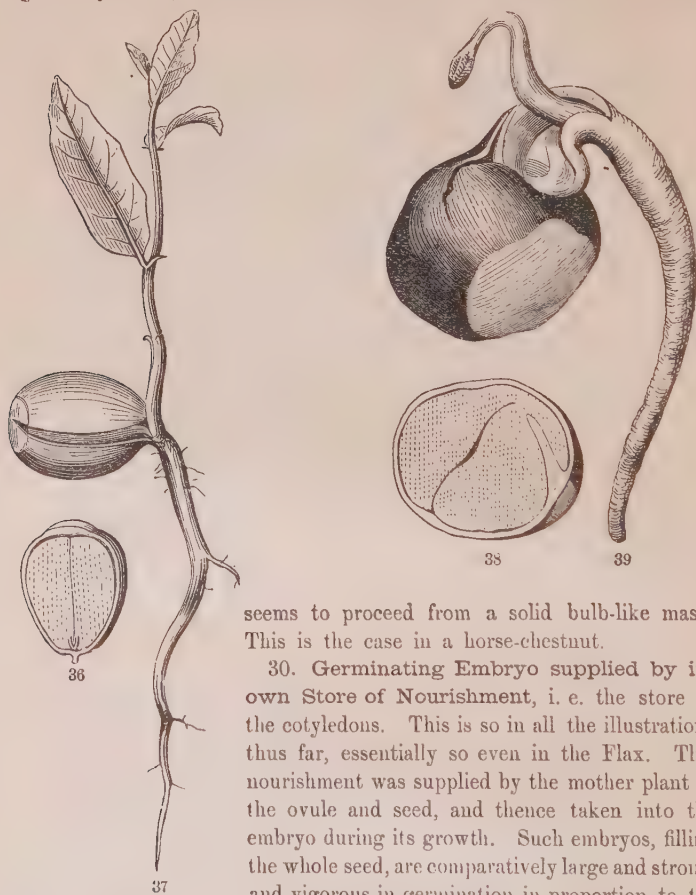
this lengthens hardly any. Indeed, the earliest growth which carries the very short caulicle out of the shell comes from the formation of foot-stalks to the cotyledons; above these develops the strong plumule, below grows the stout root. The growth is at first entirely, for a long time

FIG. 31. A Beech-nut, cut across. 32. Beginning germination of the Beech, showing the plumule growing before the cotyledons have opened or the root has scarcely formed. 33. The same, a little later, with the plumule-leaves developing, and elevated on a long internode.

FIG. 34. Embryo of Pea, i. e. a pea with the coats removed; the short and thick caulicle presented to view. 35. Same in advanced germination: the plumule has developed four or five internodes, bearing single leaves; but the first and second leaves are mere scales, the third begins to serve as foliage; the next more so.

mainly, at the expense of the great store of food in the cotyledons. These, after serving their purpose, decay and fall away.

29. Such thick cotyledons never separate; indeed, they sometimes grow together by some part of their contiguous faces; so that the germination



seems to proceed from a solid bulb-like mass. This is the case in a horse-chestnut.

30. Germinating Embryo supplied by its own Store of Nourishment, i. e. the store in the cotyledons. This is so in all the illustrations thus far, essentially so even in the Flax. This nourishment was supplied by the mother plant to the ovule and seed, and thence taken into the embryo during its growth. Such embryos, filling the whole seed, are comparatively large and strong, and vigorous in germination in proportion to the amount of their growth while connected with the parent plant.

31. Germinating Embryo supplied from a Deposit outside of Itself. This is as common as the other mode; and it occurs in all degrees.

FIG. 36. Half of an acorn, cut lengthwise, filled by the very thick cotyledons, the base of which encloses the minute caulicle. 37. Oak-seedling.

FIG. 38. Half of a horse-chestnut, similarly cut; the caulicle is curved down on the side of one of the thick cotyledons. 39. Horse-chestnut in germination; foot-stalks are formed to the cotyledons, pushing out in their lengthening the growing parts.

Some seeds have very little of this deposit, but a comparatively large embryo, with its parts more or less developed and recognizable. In others this deposit forms the main bulk of the seed, and the embryo is small or minute, and comparatively rudimentary. The following illustrations exemplify these various grades. When an embryo in a seed is thus surrounded by a white substance, it was natural to liken the latter to the white of an egg, and the embryo or germ to the yolk. So the matter around or by the side of the embryo was called the *Albumen*, i. e. the white of the seed. The analogy is not very good; and to avoid ambiguity some botanists call it the *ENDOSPERM*. As that means in English merely the inwards of a seed, the new name is little better than the old one; and, since we do not change names in botany except when it cannot be avoided, this name of *albumen* is generally kept up. A seed with such a deposit is *albuminous*, one with none is *exalbuminous*.

32. The *ALBUMEN* forms the main bulk of the seed in wheat, maize, rice, buckwheat, and the like. It is the floury part of the seed. Also of the cocoa-nut, of coffee (where it is dense and hard), etc.; while in peas, beans, almonds, and in most edible nuts, the store of food, although essentially the same in nature and in use, is in the embryo itself, and therefore is not counted as anything to be separately named. In both forms this concentrated food for the germinating plant is food also for man and for animals.

33. For an albuminous seed with a well-developed embryo, the common Morning Glory (*Ipomœa purpurea*, Fig. 40-43) is a convenient example, being easy and prompt to grow, and having all the parts well apparent. The seeds (duly soaked for examination) and the germination should be compared with those of Sugar and Red Maple (19-21). The only essential difference is that here the embryo is surrounded by and crumpled up in the albumen. This substance, which is pulpy or mucilaginous in fresh and young seeds, hardens as the seed ripens, but becomes again pulpy in germination; and, as it liquifies, the thin cotyledons absorb it by their



FIG. 40. Seed of Morning Glory divided, moderately magnified; shows a longitudinal section through the centre of the embryo as it lies crumpled in the albumen. 41. Embryo taken out whole and unfolded; the broad and very thin cotyledons notched at summit; the caulicle below. 42. Early state of germination. 43. Same, more advanced; caulicle or primary stem, cotyledons or seed leaves, and below, the root, well developed.

whole surface. It supplements the nutritive matter contained in the embryo. Both together form no large store, but sufficient for establishing the seedling, with tiny root, stem, and pair of leaves for initiating its independent growth; which in due time proceeds as in Fig. 44, 45.

34. Smaller embryos, less developed in the seed, are more dependent upon the extraneous supply of food. The figures 46-53 illustrate four



grades in this respect. The smallest, that of the Peony, is still large enough to be seen with a hand magnifying glass, and even its cotyledons may be discerned by the aid of a simple stage microscope.

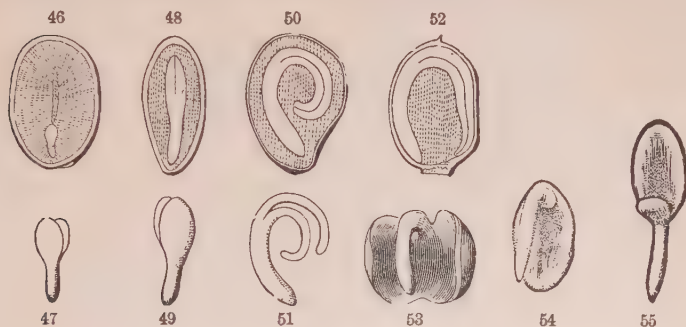
35. The broad cotyledons of *Mirabilis*, or Four-o'clock (Fig. 52, 53), with the slender caulicle almost encircle and enclose the floury albumen, instead of being enclosed in it, as in the other illustrations. Evidently here the germinating embryo is principally fed by one of the leaf-like cotyledons, the other being out of contact with the supply. In the embryo of *Abronia* (Fig. 54, 55), a near relative of *Mirabilis*, there is a singular modification; one cotyledon is almost wanting, being reduced to a rudiment, leaving it for the other to do the work. This leads to the question of the

36. Number of Cotyledons. In all the preceding illustrations, the embryo, however different in shape and degree of development, is evidently

FIG. 44. Seedling of Morning Glory more advanced (root cut away); cotyledons well developed into foliage-leaves; succeeding internode and leaf well developed, and the next forming. 45. Seedling more advanced; reduced to much below natural size.

constructed upon one and the same plan, namely, that of two leaves on a caulicle or initial stem, — a plan which is obvious even when one cotyledon becomes very much smaller than the other, as in the rare instance of *Abroonia* (Fig. 54, 55). In other words, the embryos so far examined are all

37. **Dicotyledonous**, that is, two-cotyledoned. Plants which are thus similar in the plan of the embryo agree likewise in the general structure of



their stems, leaves, and blossoms; and thus form a class, named from their embryo **DICOTYLEDONES**, or in English, **DICOTYLEDONOUS PLANTS**. So long a name being inconvenient, it may be shortened into **DICOTYLS**.

38. **Polycotyledonous** is a name employed for the less usual case in which there are more than two cotyledons. The Pine is the most familiar case. This occurs in all Pines, the number of cotyledons varying from three to twelve; in Fig. 56, 57 they are six. Note that they are all on the same level, that is, belong to the same node, so as to form a circle or *whorl* at the summit of the caulicle. When there are only three cotyledons, they divide the space equally, are one third of the circle apart. When only two they are 180° apart, that is, are *opposite*.

39. The case of three or more cotyledons, which is constant in Pines and in some of their relatives (but not in all of them), is occasional among Dicotyls. And the polycotyledonous is only a variation of the dicotyledonous type, — a difference in the number of leaves in the whorl; for a pair is a whorl reduced to two members. Some suppose that there are really only

FIG. 46. Section of a seed of a Peony, showing a very small embryo in the albumen, near one end. 47. This embryo detached, and more magnified.

FIG. 48. Section of a seed of Barberry, showing the straight embryo in the middle of the albumen. 49. Its embryo detached.

FIG. 50. Section of a Potato-seed, showing the embryo coiled in the albumen. 51. Its embryo detached.

FIG. 52. Section of the seed of *Mirabilis* or Four-o'clock, showing the embryo coiled round the outside of the albumen. 53. Embryo detached; showing the very broad and leaf-like cotyledons, applied face to face, and the pair incurved.

FIG. 54. Embryo of *Abroonia umbellata*; one of the cotyledons very small. 55. Same straightened out.

two cotyledons even in a Pine-embryo, but these divided or split up congenitally so as to imitate a greater number. But as leaves are often in whorls on ordinary stems, they may be so at the very beginning.

40. **Monocotyledonous** (meaning with single cotyledon) is the name of the one-cotyledoned sort of embryo. This goes along with peculiarities in stem, leaves, and flowers; which all together associate such plants into a great class, called **MONOCOTYLEDONOUS PLANTS**, or, for shortness, **MONOCOTYLS**. It means merely that the leaves are alternate from the very first.

41. In *Iris* (Fig. 58, 59) the embryo in the seed is a small cylinder at one end of the mass of the albumen, with no apparent distinction of parts. The end which almost touches the seed-coat is caulicle; the other end belongs to the solitary cotyledon. In

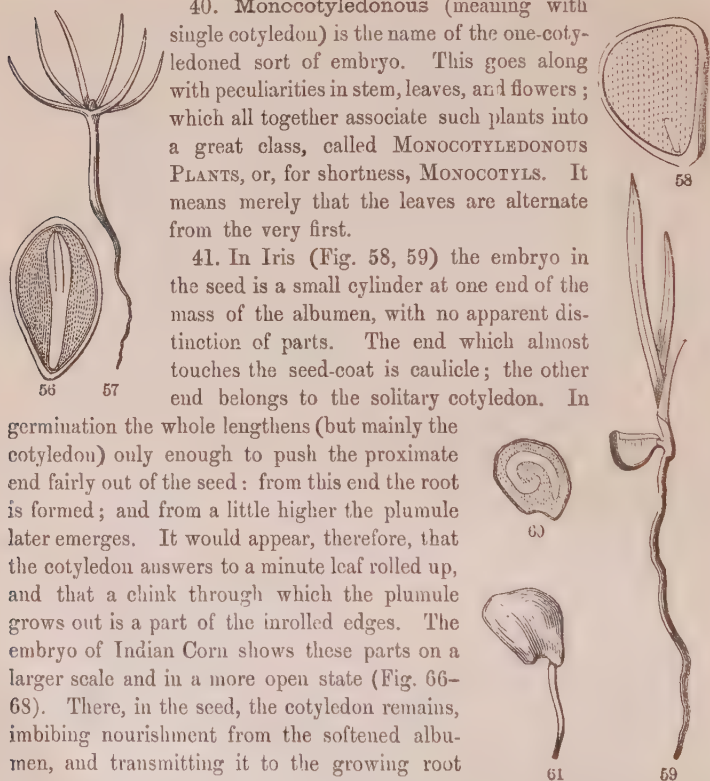
germination the whole lengthens (but mainly the cotyledon) only enough to push the proximate end fairly out of the seed: from this end the root is formed; and from a little higher the plumule later emerges. It would appear, therefore, that the cotyledon answers to a minute leaf rolled up, and that a chink through which the plumule grows out is a part of the inrolled edges. The embryo of Indian Corn shows these parts on a larger scale and in a more open state (Fig. 66-68). There, in the seed, the cotyledon remains, imbibing nourishment from the softened albumen, and transmitting it to the growing root below and new-forming leaves above.

42. The general plan is the same in the *Onion* (Fig. 60-65), but with a striking difference. The embryo is long, and coiled in the albumen of the seed. To ordinary examination it shows no distinction of parts. But germination plainly shows that all except the lower end of it is cotyledon. For after it has lengthened into a long thread, the chink from which the

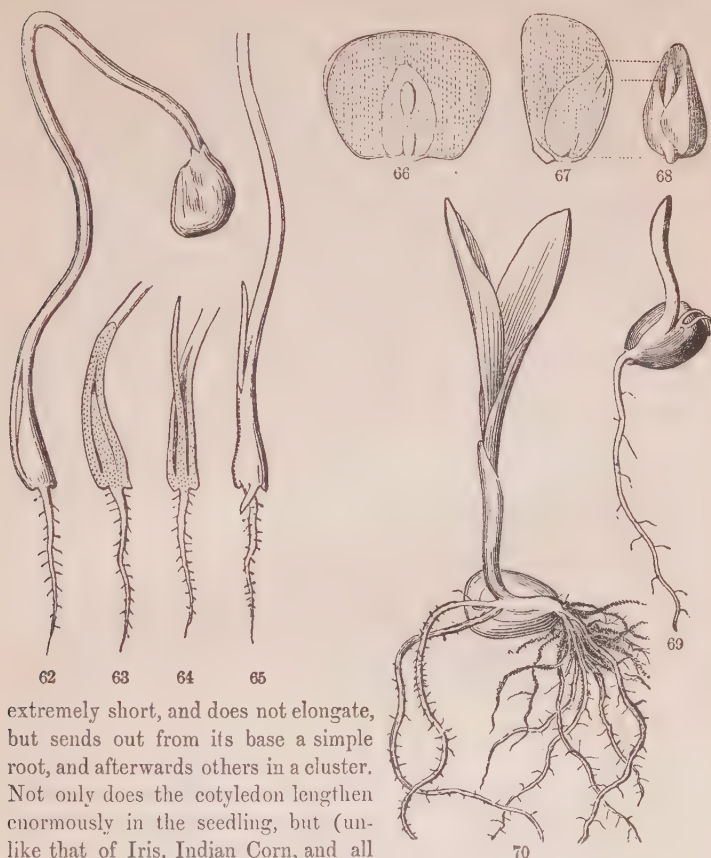
FIG. 56. Section of a Pine-seed, showing its polycotyledonous embryo in the centre of the albumen; moderately magnified. 57. Seedling of same, showing the freshly expanded six cotyledons in a whorl, and the plumule just appearing.

Fig. 58. Section of a seed of the *Iris*, or *Flower-de-Luce*, enlarged, showing its small embryo in the albumen, near the bottom. 59. A germinating seedling of the same, its plumule developed into the first four leaves (alternate), the first one rudimentary; the cotyledon remains in the seed.

FIG. 60. Section of an *Onion*-seed, showing the slender and coiled embryo in the albumen; moderately magnified. 61. Seed of same in early germination.



plumule in time emerges is seen at the base, or near it; so the caulicle is



extremely short, and does not elongate, but sends out from its base a simple root, and afterwards others in a cluster. Not only does the cotyledon lengthen enormously in the seedling, but (unlike that of *Iris*, *Indian Corn*, and all

FIG. 62. Germinating Onion, more advanced; the chink at base of cotyledon opening for the protrusion of the plumule, consisting of a thread-shaped leaf. 63. Section of base of Fig. 62, showing plumule enclosed. 64. Section of same later; plumule emerging. 65. Later stage of 62; upper part cut off. 66. A grain of *Indian Corn*, flatwise, cut away a little, so as to show the embryo, lying on the albumen, which makes the principal bulk of the seed. 67. A grain cut through the middle in the opposite direction, dividing the embryo through its thick cotyledon and its plumule, the latter consisting of two leaves, one enclosing the other. 68. The embryo, taken out whole: the thick mass is the cotyledon; the narrow body partly enclosed by it is the plumule; the little projection at its base is the very short radicle enclosed in the sheathing base of the first leaf of the plumule.

FIG. 69. Grain of *Indian Corn* in germination; the ascending sprout is the first leaf of the plumule, enclosing the younger leaves within; at its base the primary root has broken through. 70. The same, advanced; the second and third leaves developing, while the sheathing first leaf does not further develop.

the cereal grains) it raises the comparatively light seed into the air, the tip still remaining in the seed and feeding upon the albumen. When this food is exhausted and the seedling is well established in the soil, the upper end decays and the emptied husk of the seed falls away.



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43. In Maize or Indian Corn (Fig. 66-70), the embryo is more developed in the seed, and its parts can be made out. It lies against the starchy albumen, but is not enclosed therein. The larger part of it is the cotyledon, thickish, its edges involute, and its back in contact with the albumen; partly enclosed by it is the well-developed plumule or bud which is to grow. For the cotyledon remains in the seed to fulfil its office of imbibing nourishment from the softened albumen, which it conveys to the growing sprout; the

part of this sprout which is visible is the first leaf of the plumule rolled up into a sheath and enclosing the rudiments of the succeeding leaves, at the base enclosing even the minute caulicle. In germination the first leaf of the plumule develops only as a sort of sheath, protecting the tender parts within; the second and the third form the first foliage. The caulicle never lengthens: the first root, which is formed at its lower end, or from any part of it, has to break through the enclosing sheath; and succeeding roots soon spring from all or any of the nodes of the plumule.

44. **Simple-stemmed Plants** are thus built up, by the continuous production of one leaf-bearing portion of stem from the summit of the preceding one, beginning with the initial stem (or caulicle) in the embryo. Some Dicotyls and many Monocotyls develop only in this single line of growth (as to parts above ground) until the flowering state is approached. For some examples, see *Cycas* (Fig. 71, front, at the left); a tall *Yucca* or Spanish Bayonet, and two *Cocoa-nut Palms* behind; at the right, a group of *Sugarcanes*, and a *Banana* behind.

FIG. 71. Simple-stemmed vegetation.

SECTION IV. GROWTH FROM BUDS: BRANCHING.

45. Most plants increase the amount of their vegetation by branching, that is, by producing lateral shoots.

46. Roots branch from any part and usually without definite order. Stems normally give rise to branches only at definite points, namely, at the nodes, and there only from the axils of leaves.

47. Buds (Fig. 72, 73). Every incipient shoot is a *Bud* (12). A stem continues its growth by its *terminal bud*; it branches by the formation and development of *lateral buds*. As normal lateral buds occupy the axils of leaves, they are called *axillary buds*. As leaves are symmetrically arranged on the stem, the buds in their axils and the branches into which axillary buds grow partake of this symmetry. The most conspicuous buds are the scaly winter-buds of most shrubs and trees of temperate and cold climates; but the name belongs as well to the forming shoot or branch of any herb.

48. The *Terminal Bud*, in the most general sense, may be said to exist in the embryo, — as cotyledons, or the cotyledons and plumule, — and to crown each successive growth of the simple stem so long as the summit is capable of growth. The whole ascending growth of the Palm, Cycas, and the like (such as in Fig. 71) is from a terminal bud. Branches, being repetitions of the main stem and growing in the same way, are also lengthened by terminal buds. Those of Horse-chestnut, Hickory, Maples, and such trees, being the resting buds of winter, are conspicuous by their protective covering of scales. These bud-scales, as will hereafter be shown, are themselves a kind of leaves.

49. *Axillary Buds* were formed on these annual shoots early in the summer. Occasionally they grow the same season into branches; at least, some of them are pretty sure to do so whenever the growing terminal bud at the end of the shoot is injured or destroyed. Otherwise they may lie dormant until the following spring. In many trees or shrubs these axillary buds do not show themselves until spring; but if searched for, they may be detected, though of small size, hidden under the bark. Sometimes, although early

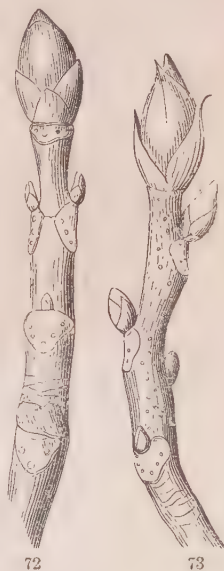


FIG. 72. Shoot of Horse-chestnut, of one year's growth, taken in autumn after the leaves have fallen; showing the large terminal bud and smaller axillary buds.

FIG. 73. Similar shoot of Shagbark Hickory, *Carya alba*.

formed, they are concealed all summer long under the base of the leaf-stalk, which is then hollowed out into a sort of inverted cup, like a candle-extinguisher, to cover them; as in the Locust, the Yellow-wood, or more strikingly in the Button-wood or Plane-tree (Fig. 74).



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50. The *leaf-scars*, so conspicuous in Fig. 72, 73, under each axillary bud, mark the place where the stalk of the subtending leaf was attached until it fell in autumn.

51. *Scaly Buds*, which are well represented in Fig. 72, 73, commonly belong to trees and shrubs of countries in which growth is suspended during winter. The scaly coverings protect the tender young parts beneath, not so much by keeping out the cold, which of course would penetrate the bud in time, as by shielding the interior from the effects of sudden changes. There are all gradations between these and

52. *Naked Buds*, in which these scales are inconspicuous or wanting, as in most herbs, at least above ground, and most tropical trees and shrubs. But nearly related plants of the same climate may differ widely in this respect. *Rhododendrons* have strong and scaly winter-buds; while in *Kalmia* they are naked. One species of *Viburnum*, the Hobble-bush, has completely naked buds, what would be a pair of scales developing into the first leaves in spring; while another (the Snowball) has conspicuous scaly buds.

53. *Vigor of Vegetation from strong buds*. Large and strong buds, like those of the Horse-chestnut, Hickory, and the like, contain several leaves, or pairs of leaves, ready formed, folded and packed away in small compass, just as the seed-leaves of a strong embryo are packed away in the seed: they may even contain all the blossoms of the ensuing season, plainly visible as small buds. And the stems upon which these buds rest are filled with abundant nourishment, which was deposited the summer before in the

FIG. 74. An axillary bud, concealed under the hollowed base of the leafstalk, in Buttonwood or Plane-tree.

wood or in the bark. Under the surface of the soil, or on it covered with the fallen leaves of autumn, similar strong buds of our perennial herbs may be found; while beneath are thick roots, rootstocks, or tubers, charged with a great store of nourishment for their use. This explains how it is that vegetation from such buds shoots forth so vigorously in the spring of the year, and clothes the bare and lately frozen surface of the soil, as well as the naked boughs of trees, very promptly with a covering of fresh green, and often with brilliant blossoms. Everything was prepared, and even formed, beforehand: the short joints of stem in the bud have only to lengthen, and to separate the leaves from each other so that they may unfold and grow. Only a small part of the vegetation of the season comes directly from the seed, and none of the earliest vernal vegetation. This is all from buds which have lived through the winter.

54. **The Arrangement of Branches**, being that of axillary buds, answers to that of the leaves. Now leaves principally are either *opposite* or *alternate*. Leaves are *opposite* when there are two from the same joint of stem, as in Maples (Fig. 20), the two being on opposite sides of the stem; and so the axillary buds and branches are opposite, as in Fig. 75. Leaves are *alternate* when there is only one from each joint of stem, as in the Oak, Lime-tree, Poplar, Button-wood (Fig. 74), Morning-Glory (Fig. 45, — not counting the seed-leaves, which of course are opposite, there being a pair of them); also in Indian Corn (Fig. 70), and Iris (Fig. 59). Consequently the axillary buds are also alternate, as in Hickory (Fig. 73); and the branches they form alternate, — making a different kind of spray from the other mode, one branch shooting on one side of the stem and the next on some other. For in the alternate arrangement no leaf is on the same side of the stem as the one next above or next below it.

55. But the symmetry of branches (unlike that of the leaves) is rarely complete. This is due to several causes, and most commonly to the

56. **Non-development of buds.** It never happens that all the buds grow. If they did, there might be as many branches in any year as there were leaves the year before. And of those which do begin to grow, a large portion perish, sooner or later, for want of nourishment, or for want of light, or because those which first begin to grow have an advantage, which they are apt to keep, taking to themselves the nourishment of the stem, and starving the weaker buds. In the Horse-chestnut (Fig. 72), Hickory (Fig. 73), Magnolia, and most other trees with large scaly buds, the terminal bud is the strongest, and has the advantage in growth; and next in strength are the upper axillary buds: while the former continues the shoot of the last year, some of the latter give rise to branches, and the rest fail to grow. In the Lilac also (Fig. 75), the uppermost axillary buds are stronger than the lower; but the terminal bud rarely appears at all; in its place the uppermost pair of axillary buds grow, and so each stem branches every year into two, — making a repeatedly two-forked ramification, as in Fig. 76.

57. Latent Buds. Axillary buds that do not grow at the proper season, and especially those which make no appearance externally, may long remain latent, and at length upon a favorable occasion start into growth, so forming

branches apparently out of place as they are out of time. The new shoots seen springing directly out of large stems may sometimes originate from such latent buds, which have preserved their life for years. But commonly these arise from

58. Adventitious Buds. These are buds which certain shrubs and trees produce anywhere on the surface of the wood, especially where it has been injured. They give rise to the slender twigs which often feather the sides of great branches of our American Elms. They sometimes form on the root, which naturally is destitute of buds; they are even found upon some leaves; and they are sure to appear on the trunks and roots of Willows, Poplars, and Chestnuts, when these are wounded or mutilated. Indeed Osier-Willows are *pollarded*, or cut off, from time to time, by the cultivator, for the purpose of producing

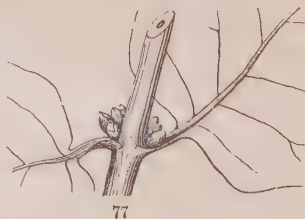
a crop of slender adventitious twigs, suitable for basket-work. Such branches, being altogether irregular, of course interfere with the natural symmetry of the tree. Another cause of irregularity, in certain trees and shrubs, is the formation of what are called

59. Accessory or Supernumerary Buds. There are cases where two, three, or more buds spring from the axil of a leaf, instead of the single one which is ordinarily found there. Sometimes they are placed one over the other, as in the Aristolochia or Pipe-Vine, and in the Tartarean Honeysuckle (Fig. 77); also in the Honey-Locust, and in the Walnut and Butternut (Fig. 78), where



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FIG. 75. Shoot of Lilac, with winter buds; the two uppermost axillary ones strong; the terminal not developed. 76. Forking ramification of Lilac; reduced in size.

FIG. 77. Tartarean Honeysuckle, with three accessory buds in each axil.

the upper supernumerary bud is a good way out of the axil and above the others. And this is here stronger than the others, and grows into a branch which is considerably out of the axil, while the lower and smaller ones commonly do not grow at all. In other cases three buds stand side by side in the axil, as in the Hawthorn, and the Red Maple (Fig. 79.) If these were all to grow into branches, they would stifle each other. But some of them are commonly flower-buds : in the Red Maple, only the middle one is a leaf-bud, and it does not grow until after those on each side of it have expanded the blossoms they contain.

60. **Sorts of Buds.** It may be useful to enumerate the kinds of buds which have been described or mentioned. They are

Terminal, when they occupy the summit of (or terminate) a stem,

Lateral, when they are borne on the side of a stem ; of which the regular kind is the

Axillary, situated in the axil of a leaf. These are

Accessory or *Supernumerary*, when they are in addition to the normal solitary bud ; and these are *Collateral*, when side by side ; *Superposed*, when one above another ;

Extra-axillary, when they appear above the axil, as some do when superposed, and as occasionally is the case when single.

Naked buds ; those which have no protecting scales.

Scaly buds ; those which have protecting scales, which are altered leaves or bases of leaves.

Leaf-buds, contain or give rise to leaves, and develop into a leafy shoot.

Flower-buds, contain or consist of blossoms, and no leaves.

Mixed buds, contain both leaves and blossoms.



61. **Definite annual Growth** from winter buds is marked in most of the shoots from strong buds, such as those of the Horse-chestnut and Hickory (Fig. 72, 73). Such a bud generally contains, already formed in miniature, all or a great part of the leaves and joints of stem it is to produce, makes its whole growth in length in the course of a few weeks, or sometimes even in a few days, and then forms and ripens its buds for the next year's similar growth.

62. **Indefinite annual Growth**, on the other hand, is well marked in such trees or shrubs as the Honey-Locust, Sumac, and in sterile shoots of

FIG. 78. Butternut branch, with accessory buds, the uppermost above the axil.

FIG. 79. Red-Maple branch, with accessory buds placed side by side. The annular lines toward the base in this and in Fig. 72 are scars of the bud-scales, and indicate the place of the winter-bud of the preceding year.

the Rose, Blackberry, and Raspberry. That is, these shoots are apt to grow all summer long, until stopped by the frosts of autumn or some other causé. Consequently they form and ripen no terminal bud protected by scales, and the upper axillary buds are produced so late in the season that they have no time to mature, nor has their wood time to solidify and ripen. Such stems therefore commonly die back from the top in winter, or at least all their upper buds are small and feeble; so the growth of the succeeding year takes place mainly from the lower axillary buds, which are more mature.

63. **Deliquescent and Excurrent Growth.** In the former case, and wherever axillary buds take the lead, there is, of course, no single main stem, continued year after year in a direct line, but the trunk is soon lost



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in the branches. Trees so formed commonly have rounded or spreading tops. Of such trees with *deliquescent* stems,—that is, with the trunk dissolved, as it were, into the successively divided branches,—the common American Elm (Fig. 80) is a good illustration.

64. On the other hand, the main stem of Firs and Spruces, unless destroyed by some injury, is carried on in a direct line throughout the whole growth of the tree, by the development year after year of a terminal bud: this forms a single, uninterrupted shaft,—an *excurrent* trunk, which cannot be confounded with the branches that proceed from it. Of such *spiry* or *spire-shaped* trees, the Firs or Spruces are characteristic and familiar examples. There are all gradations between the two modes.

FIG. 80. An American Elm, with Spruce-trees, and on the left Arbor Vitæ.

SECTION V. ROOTS.

65. It is a property of stems to produce roots. Stems do not spring from roots in ordinary cases, as is generally thought, but roots from stems. When perennial herbs arise from the ground, as they do at spring-time, they rise from subterranean stems.

66. The **Primary Root** is a downward growth from the root-end of the caulicle, that is, of the initial stem of the embryo (Fig. 5-7, 81). If it goes on to grow it makes a *main* or *tap-root*, as in Fig. 37, etc. Some plants keep this main root throughout their whole life, and send off only small side branches; as in the Carrot and Radish: and in various trees, like the Oak, it takes the lead of the side-branches for several years, unless accidentally injured, as a strong tap-root. But commonly the main root divides off very soon, and is lost in the branches. *Multiple primary roots* now and then occur, as in the seedling of Pumpkin (Fig. 27), where a cluster is formed even at the first, from the root-end of the caulicle.

67. **Secondary Roots** are those which arise from other parts of the stem. Any part of the stem may produce them, but they most readily come from the nodes. As a general rule they naturally spring, or may be made to spring, from almost any young stem, when placed in favorable circumstances,—that is, when placed in the soil, or otherwise supplied with moisture and screened from the light. For the special tendency of the root is to avoid the light, seek moisture, and therefore to bury itself in the soil. *Propagation by division*, which is so common and so very important in cultivation, depends upon the proclivity of stems to strike root. Stems or branches which remain under ground give out roots as freely as roots themselves give off branches. Stems which creep on the ground most commonly root at the joints; so will most branches when bent to the ground, as in propagation by *layering*; and propagation by *cuttings* equally depends upon the tendency of the cut end of a shoot to produce roots. Thus, a piece of a plant which has stem and leaves, either developed or in the bud, may be made to produce roots, and so become an independent plant.

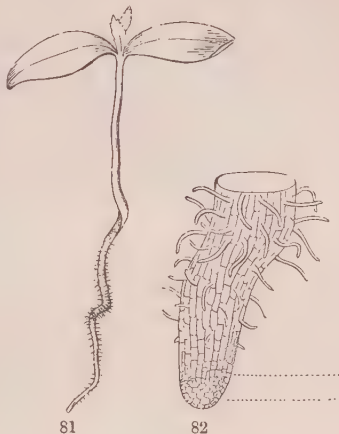
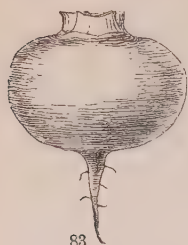


FIG. 81. Seedling Maple, of the natural size; the root well supplied with root-hairs, here large enough to be seen by the naked eye. 82. Lower end of this root, magnified, the root seen just as root hairs are beginning to form a little behind the tip.

68. **Contrast between Stem and Root.** Stems are ascending axes; roots are descending axes. Stems grow by the successive development of internodes (13), one after another, each leaf-bearing at its summit (or node); so that it is of the essential nature of a stem to bear leaves. Roots bear no leaves, are not distinguishable into nodes and internodes, but grow on continuously from the lower end. They commonly branch freely, but not from any fixed points nor in definite order.



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69. Although roots generally do not give rise to stems, and therefore do not propagate the plant, exceptions are not uncommon. For as stems may produce adventitious buds, so also may roots. The roots of the Sweet Potato among herbs, and of the Osage Orange among trees freely produce adventitious buds, developing into leafy shoots; and so these plants are propagated by *root-cuttings*. But most growths of subterranean origin

which pass for roots are forms of stems, the common Potato for example.

70. Roots of ordinary kinds and uses may be roughly classed into *fibrous* and *fleshy*.

71. **Fibrous Roots**, such as those of Indian Corn (Fig. 70), of most annuals, and of many perennials, serve only for absorption: these are slender or thread-like. Fine roots of this kind, and the fine branches which most roots send out are called **ROOTLETS**.

72. The whole surface of a root absorbs moisture from the soil while fresh and new; and the newer roots and rootlets are, the more freely do they imbibe. Accordingly, as long as the plant grows above ground, and expands fresh foliage, from which moisture largely escapes into the air, so long it continues to extend and multiply its roots in the soil beneath, renewing and increasing the fresh surface for absorbing moisture, in proportion to the demand from above. And when growth ceases above ground, and the leaves die and fall, or no longer act, then the roots generally stop growing,

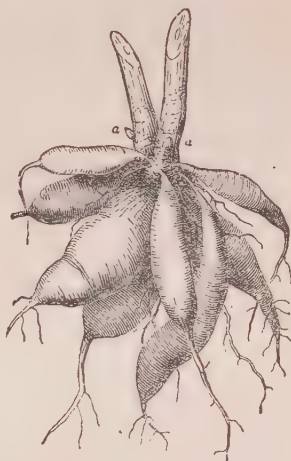
FIG. 83-85. Forms of tap-root.

and their soft and tender tips harden. From this period, therefore, until growth begins anew the next spring, is the best time for transplanting; especially for trees and shrubs.

73. The absorbing surface of young roots is much increased by the formation, near their tips, of **ROOT-HAIRS** (Fig. 81, 82), which are delicate



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tubular outgrowths from the surface, through the delicate walls of which moisture is promptly imbibed.

74. **Fleshy Roots** are those in which the root becomes a storehouse of nourishment. Typical roots of this kind are those of such biennials as the turnip and carrot; in which the food created in the first season's vegetation is accumulated, to be expended the next season in a vigorous growth and a rapid development of flowers, fruit, and seed. By the time the seed is matured the exhausted root dies, and with it the whole plant.

75. Fleshy roots may be single or multiple. The single root of the commoner biennials is the primary root, or tap-root, which begins to thicken in the seedling. Names are given to its shapes, such as

Conical, when it thickens most at the crown, or where it joins the stem, and tapers regularly downwards to a point, as in the Parsnip and Carrot (Fig. 84);

Turnip-shaped or *napiform*, when greatly thickened above, but abruptly becoming slender below; as the Turnip (Fig. 83); and

FIG. 86. Sweet-Potato plant forming thickened roots. Some in the middle are just beginning to thicken; one at the left has grown more; one at the right is still larger.

FIG. 87. Fascicled fusiform roots of a Dahlia: *a, a*, buds on base of stem.

Spindle-shaped, or *Fusiform*, when thickest in the middle and tapering to both ends; as the common Radish (Fig. 85).

76. These examples are of primary roots. It will be seen that turnips, carrots, and the like, are not pure root throughout; for the caulicle, from the lower end of which the root grew, partakes of the thickening, perhaps also some joints of stem above: so the bud-bearing and growing top is stem.

77. A fine example of secondary roots (67), some of which remain fibrous for absorption, while a few thicken and store up food for the next season's growth, is furnished by the Sweet Potato (Fig. 86). As stated above, these are used for propagation by cuttings; for any part will produce adventitious buds and shoots. The Dahlia produces *fusculated* (i. e. clustered) fusiform roots of the same kind, at the base of the stem (Fig. 87): but these, like most roots, do not produce adventitious buds. The buds by which Dahlias are propagated belong to the surviving base of the stem above.

78. *Anomalous Roots*, as they may be called, are those which subserve other uses than absorption, food-storing, and fixing the plant to the soil.

Aerial Roots, i. e. those that strike from stems in the open air, are common in moist and warm climates, as in the Mangrove which reaches the coast of Florida, the Banyan, and, less strikingly, in some herbaceous plants, such as Sugar Cane, and even in Indian Corn. Such roots reach the ground at length, or tend to do so.

Aerial Rootlets are abundantly produced by many climbing plants, such as the Ivy, Poison Ivy, Trumpet Creeper, etc., springing from the side of stems, which they fasten to trunks of trees, walls, or other supports. These are used by the plant for climbing.

79. *Epiphytes*, or *Air-Plants* (Fig. 88), are called by the former name because commonly growing

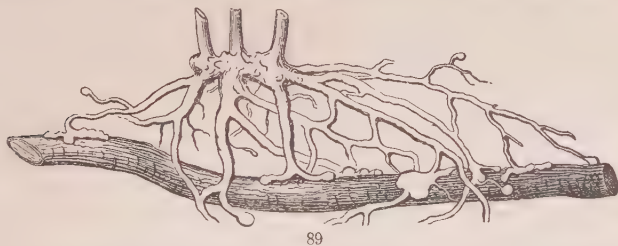


FIG. 88. Epiphytes of Florida and Georgia, viz., *Epidendrum conopseum*, a small Orchid, and *Tillandsia usneoides*, the so called Long Moss or Black Moss, which is no moss, but a flowering plant, also *T. recurvata*; on a bough of Live Oak.

upon the trunks or limbs of other plants; by the latter because, having no connection with the soil, they must derive their sustenance from the air only. They have aerial roots, which do not reach the ground, but are used to fix the plant to the surface upon which the plant grows: they also take a part in absorbing moisture from the air.

80. **Parasitic Plants**, of which there are various kinds, strike their roots, or what answer to roots, into the tissue of foster plants, or form attachments with their surface, so as to prey upon their juices. Of this sort is the Mistletoe, the seed of which germinates on the bough where it falls or is left by birds; and the forming root penetrates the bark and engrafts itself into the wood, to which it becomes united as firmly as a natural branch to its parent stem; and indeed the parasite lives just as if it were a branch of the tree it grows and feeds on. A most common parasitic herb is the Dodder; which abounds in low grounds in summer, and coils its long and slender, leafless, yellowish stems — resembling tangled threads of yarn — round and round the stalks of other plants; wherever they touch piercing the bark with minute and very short rootlets in the form of suckers, which draw out the nourishing juices of the plants laid hold of. Other parasitic plants, like the Beech-drops and Pine-sap, fasten their roots under ground upon the roots of neighboring plants, and rob them of their juices.

81. Some plants are partly parasitic; while most of their roots act in the ordinary way, others make suckers at their tips which grow fast to the



roots of other plants and rob them of nourishment. Some of our species of *Gerardia* do this (Fig. 89).

82. There are phanerogamous plants, like *Monotropa* or Indian Pipe, the roots of which feed mainly on decaying vegetable matter in the soil. These are **SAPROPHYTES**, and they imitate Mushrooms and other Fungi in their mode of life.

83. **Duration of Roots, etc.** Roots are said to be either *annual*, *biennial*, or *perennial*. As respects the first and second, these terms may be applied either to the root or to the plant.

84. **Annuals**, as the name denotes, live for only one year, generally for

FIG. 89. Roots of Yellow *Gerardia*, some attached to and feeding on the root of a Blueberry-bush.

only a part of the year. They are of course herbs; they spring from the seed, blossom, mature their fruit and seed, and then die, root and all. Annuals of our temperate climates with severe winters start from the seed in spring, and perish at or before autumn. Where the winter is a moist and growing season and the summer is dry, *winter annuals* prevail; their seeds germinate under autumn or winter rains, grow more or less during winter, blossom, fructify, and perish in the following spring or summer. Annuals are fibrous-rooted.

85. **Biennials**, of which the Turnip, Beet, and Carrot are familiar examples, grow the first season without blossoming, usually thicken their roots, laying up in them a stock of nourishment, are quiescent during the winter, but shoot vigorously, blossom, and seed the next spring or summer, mainly at the expense of the food stored up, and then die completely. Annuals and biennials flower only once; hence they have been called *Monocarpic* (that is, once-fruited) plants.

86. **Perennials** live and blossom year after year. A perennial herb, in a temperate or cooler climate, usually dies down to the ground at the end of the season's growth. But subterranean portions of stem, charged with buds, survive to renew the development. Shrubs and trees are of course perennial; even the stems and branches above ground live on and grow year after year.

87. There are all gradations between annuals and biennials, and between these and perennials, as also between herbs and shrubs; and the distinction between shrubs and trees is quite arbitrary. There are perennial herbs and even shrubs of warm climates which are annuals when raised in a climate which has a winter, — being destroyed by frost. The Castor-oil plant is an example. There are perennial herbs of which only small portions survive, as off-shoots, or, in the Potato, as tubers, etc.

SECTION VI. STEMS.

88. **The Stem** is the axis of the plant, the part which bears all the other organs. Branches are secondary stems, that is, stems growing out of stems. The stem at the very beginning produces roots, in most plants a single root from the base of the embryo-stem, or caulicle. As this root becomes a *descending axis*, so the stem, which grows in the opposite direction is called the *ascending axis*. Rising out of the soil, the stem bears leaves; and leaf-bearing is the particular characteristic of the stem. But there are forms of stems that remain underground, or make a part of their growth there. These do not bear leaves, in the common sense; yet they bear rudiments of leaves, or what answers to leaves, although not in the form of foliage. The so-called stemless or *acaulescent* plants are those which bear no obvious stem (*caulis*) above ground, but only flower-stalks, and the like.

89. Stems above ground, through differences in duration, texture, and size, form herbs, shrubs, trees, etc., or in other terms are

Herbaceous, dying down to the ground every year, or after blossoming.

Suffrutescent, slightly woody below, there surviving from year to year.

Suffruticose or *Frutescent*, when low stems are decidedly woody below, but herbaceous above.

Fruticose or *Shrubby*, woody, living from year to year, and of considerable size, — not, however, more than three or four times the height of a man.

Arborescent, when tree-like in appearance or mode of growth, or approaching a tree in size.

Arboreous, when forming a proper tree-trunk.

90. As to direction taken in growing, stems may, instead of growing upright or erect, be

Diffuse, that is, loosely spreading in all directions.

Declined, when turned or bending over to one side.

Decumbent, reclining on the ground, as if too weak to stand.

Assurgent or *Ascending*, rising obliquely upwards.

Procumbent or *Prostrate*, lying flat on the ground from the first.

Creeping or *Repent*, prostrate on or just beneath the ground, and striking root, as does the White Clover, the Partridge-berry, etc.

Climbing or *Scandent*, ascending by clinging to other objects for support, whether by *tendrils*, as do the Pea, Grape-Vine, and Passion-flower and Virginia Creeper (Fig. 92, 93); by their twisting leaf-stalks, as the Virgin's Bower; or by rootlets, like the Ivy, Poison Ivy, and Trumpet Creeper.

Twining or *Volatile*, when coiling spirally around other stems or supports; like the Morning-Glory (Fig. 90) and the Hop.



90

91. Certain kinds of stems or branches, appropriated to special uses, have received distinct substantive names; such as the following:

92. A **Culm**, or straw-stem, such as that of Grasses and Sedges.

93. A **Caudex** is the old name for such a peculiar trunk as a Palm-stem; it is also used for an upright and thick rootstock.

94. A **Sucker** is a branch rising from stems under ground. Such are produced abundantly by the Rose, Raspberry, and other plants said to multiply "by the root." If we uncover them, we see at once the great difference between these subterranean branches and real roots. They are only creeping branches under ground.

Remarking how the upright shoots from these branches become separate

FIG. 90. Twining or volatile stem of Morning-Glory.

plants, simply by the dying off of the connecting under-ground stems, the gardener expedites the result by cutting them through with his spade. That is, he propagates the plant "by division."

95. A **Stolon** is a branch from above ground, which reclines or becomes prostrate and strikes root (usually from the nodes) wherever it rests on the soil. Thence it may send up a vigorous shoot, which has roots of its own, and becomes an independent plant when the connecting part dies, as it does after a while. The Currant and the Gooseberry naturally multiply in this way, as well as by suckers (which are the same thing, only the connecting part is concealed under ground). Stolons must have suggested the operation of *layering* by bending down and covering with soil branches which do not naturally make stolons; and after they have taken root, as they almost always will, the gardener cuts through the connecting stem, and so converts a rooting branch into a separate plant.

96. An **Offset** is a short stolon, or sucker, with a crown of leaves at the end, as in the Houseleek (Fig. 91), which propagates abundantly in this way.

97. A **Runner**, of which the Strawberry presents the most familiar and characteristic example, is a long and slender, tendril-like stolon, or branch from next the ground, destitute of conspicuous leaves. Each runner of the Strawberry, after having grown to its full



length, strikes root from the tip, which fixes it to the ground, then forms a bud there, which develops into a tuft of leaves, and so gives rise to a new plant, which sends out new runners to act in the same way. In this manner a single Strawberry plant will spread over a large space, or produce a great number of plants, in the course of the summer, all connected at first by the slender runners; but these die in the following winter, if not before, and leave the plants as so many separate individuals.

98. **Tendrils** are branches of a very slender sort, like runners, not destined like them for propagation, and therefore always destitute of buds or leaves, being intended only for climbing. Simple tendrils are such as those of Passion-flowers (Fig. 92). Compound or branching tendrils are borne by the Cucumber and Pumpkin, by the Grape-Vine, Virginia Creeper, etc.

99. A tendril commonly grows straight and outstretched until it reaches some neighboring support, such as a stem, when its apex hooks around it to secure a hold; then the whole tendril shortens itself by coiling up spirally, and so draws the shoot of the growing plant nearer to the supporting object. But the tendrils of the Virginia Creeper (*Ampelopsis*, Fig.

FIG. 91. Houseleek (*Sempervivum*), with offsets

93), as also the shorter ones of the Japanese species, effect the object differently, namely, by expanding the tips of the tendrils into a flat disk, with an adhesive face. This is applied to the supporting object, and it adheres firmly; then a shortening of the tendril and



92

its branches by coiling brings up the growing shoot close to the support. This is an adaptation for climbing mural rocks or walls, or the trunks of trees, to which ordinary tendrils are unable to cling. The Ivy and Poison Ivy attain the same result by means of aerial rootlets (78).

100. Some tendrils are leaves or parts of leaves, as those of the Pea (Fig. 35). The nature of the tendril is known by its position. A tendril from the axil of a leaf, like that of Passion-flowers (Fig. 92) is of course a stem, i. e. a branch. So is one which terminates a stem, as in the Grape-Vine.

101. Spines or Thorns (Fig. 95, 96) are commonly stunted and hardened branches or tips of stems or branches, as are those of Hawthorn, Honey-Locust, etc. In the Pear and Sloe all gradations occur between spines and spine-like (spinescent) branches. Spines



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may be reduced and indurated leaves; as in the Barberry, where their nature is revealed by their situation, underneath an axillary bud. But

FIG. 92. A small Passion-flower (*Passiflora sicyoides*), showing the tendrils.

FIG. 93. Piece of the stem of Virginia Creeper, bearing a leaf and a tendril.

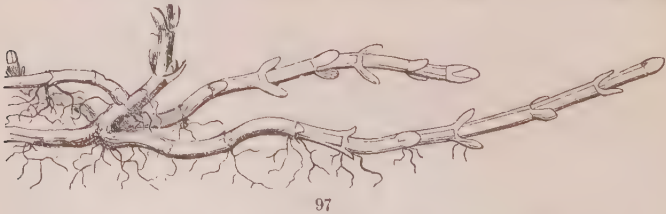
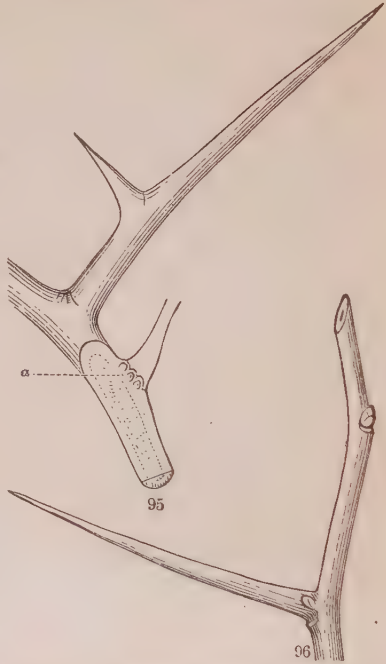
94. Tips of a tendril, about the natural size, showing the disks by which they hold fast to walls, etc.

prickles, such as those of Blackberry and Roses, are only excrescences of the bark, and not branches.

102. Equally strange forms of stems are characteristic of the Cactus family (Fig. 111). These may be better understood by comparison with

103. **Subterranean Stems and Branches.** These are very numerous and various; but they are commonly overlooked, or else are confounded with roots. From their situation they are out of ordinary sight; but they will well repay examination. For the vegetation that is carried on under ground is hardly less varied or important than that above ground. All their forms may be referred to four principal kinds: namely, the *Rhizoma* (*Rhizome*) or *Rootstock*, the *Tuber*, the *Corm* or solid bulb, and the true *Bulb*.

104. **The Rootstock, or Rhizoma,** in its simplest form, is merely a creeping stem or branch growing beneath the surface of the soil, or partly covered by it. Of this kind are the so-called *creeping*, *running*, or *scaly* roots, such as those



by which the Mint (Fig. 97), the Couch-grass, or Quick-grass, and many other plants, spread so rapidly and widely, — “by the root,” as it is said. That these are really *stems*, and not roots, is evident from the way in which

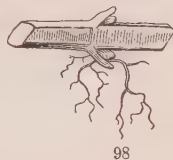
FIG. 95. A branching thorn of Honey Locust, being an indurated leafless branch developed from an accessory bud far above the axil: at the cut portion below, three other buds (α) are concealed under the petiole.

FIG. 96. Spine of Cockspur Thorn, developed from an axillary bud, as the leaf-scar below witnesses: an accessory leaf-bud is seen at its base.

FIG. 97. Rootstocks, or creeping subterranean branches, of the Peppermint.

they grow; from their consisting of a succession of joints; and from the leaves which they bear on each *node*, in the form of small scales, just like the lowest ones on the upright stem next the ground. They also produce buds in the axils of these scales, showing the scales to be leaves; whereas real roots bear neither leaves nor axillary buds. Placed as they are in the damp and dark soil, such stems naturally produce roots, just as the creeping stem does where it lies on the surface of the ground.

105. It is easy to see why plants with these running rootstocks take such rapid and wide possession of the soil, and why they are so hard to get rid of. They are always perennials; the subterranean shoots live over the first winter, if not longer, and are provided with vigorous buds at every joint. Some of these buds grow in spring into upright stems, bearing foliage, to elaborate nourishment, and at length produce blossoms for reproduction by seed; while many others, fed by nourishment supplied from above, form a new generation of subterranean shoots; and this is repeated over and over in the course of the season or in succeeding years. Meanwhile, as the subterranean shoots increase in number, the older ones, connecting the successive growths, die off year by year, liberating the already rooted side-branches as so many separate plants; and so on indefinitely. Cutting these running rootstocks into pieces, therefore, by the hoe or the plough, far from destroying the plant, only accelerates the propagation; it converts one many-branched plant into a great number of separate individuals. Cutting into pieces only multiplies the pest; for each piece (Fig. 98) is already a plantlet, with its roots and with a bud in the axil of its scale-like leaf (either latent or apparent), and with prepared nourishment enough to develop this bud into a leafy stem; and so a single plant is all the more speedily converted into a multitude. Whereas, when the subterranean parts are only roots, cutting away the stem completely destroys the plant, except in the rather rare cases where the root freely produces adventitious buds.



106. Rootstocks are more commonly thickened by the storing up of considerable nourishing matter in their tissue. The common species of *Iris* (Fig. 164) in the gardens have stout rootstocks, which are only partly covered by the soil, and which bear foliage-leaves instead of mere scales, closely covering the upper part, while the lower produces roots. As the leaves die, year by year, and decay, a scar left in the form of a ring marks the place where each leaf was attached, that is, marks so many nodes, separated by very short internodes.

107. Some rootstocks are marked with large round scars of a different

FIG. 98. A piece of the running rootstock of the Peppermint, with its node or joint, and an axillary bud ready to grow.

sort, like those of the Solomon's Seal (Fig. 99), which gave this name to the plant, from their looking somewhat like the impression of a seal upon wax. Here the

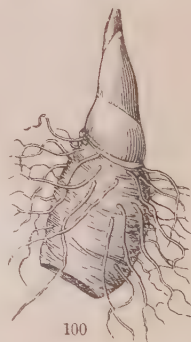


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rootstock sends up every spring an herbaceous stalk or stem, which bears the foliage and flowers, and dies in autumn. The *seal* is the circular

scar left by the death and separation of the base of the stout stalk from the living rootstock. As but one of these is formed each year, they mark the limits of a year's growth. The bud at the end of the rootstock in the figure (which was taken in summer) will grow the next spring into the stalk of the season, which, dying in autumn, will leave a similar scar, while another bud will be formed farther on, crowning the ever-advancing summit or growing end of the stem.

108. As each year's growth of stem makes its own roots, it soon becomes independent of the older parts. And after a certain age, a portion annually dies off behind, about as fast as it increases at the growing end, death following life with equal and certain step, with only a narrow interval. In vigorous plants of Solomon's Seal or Iris, the living rootstock is several inches or a foot in length; while in the short rootstock of Trillium or Birthroot (Fig. 100) life is reduced to a narrower span.



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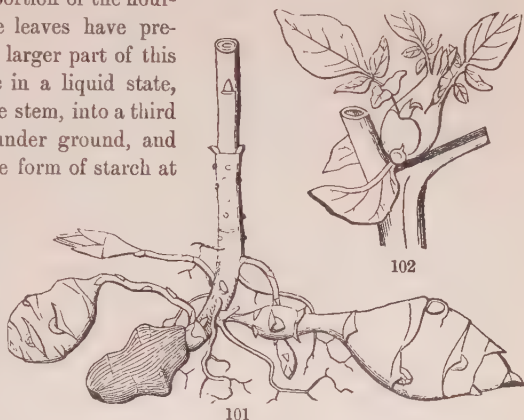
109. An upright or short rootstock, like this of Trillium, is commonly called a CAUDEX (93); or when more shortened and thickened it would become a corm.

110. A **Tuber** may be understood to be a portion of a rootstock thickened, and with buds (eyes) on the sides. Of course, there are all gradations between a tuber and a rootstock. Helianthus tuberosus, the so-called Jerusalem Artichoke (Fig. 101), and the common Potato, are typical and familiar examples of the tuber. The stalks by which the tubers are attached to the parent stem are at once seen to be different from the roots, both in appearance and manner of growth. The scales on the tubers are the rudiments of leaves; the eyes are the buds in their axils. The Potato-plant

FIG. 99. Rootstock of Solomon's Seal, with the bottom of the stalk of the season, and the bud for the next year's growth.

FIG. 100. The very short rootstock and strong terminal bud of a Trillium or Birthroot.

has three forms of branches : 1. Those that bear ordinary leaves expanded in the air, to digest what they gather from it and what the roots gather from the soil, and convert it into nourishment. 2. After a while a second set of branches at the summit of the plant bear flowers, which form fruit and seed out of a portion of the nourishment which the leaves have prepared. 3. But a larger part of this nourishment, while in a liquid state, is carried down the stem, into a third sort of branches under ground, and accumulated in the form of starch at their extremities, which become tubers, or depositories of prepared solid food,—just as in the Turnip, Carrot, and Dahlia (Fig. 83–87), it is deposited in



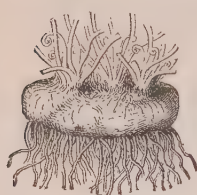
the root. The use of the store of food is obvious enough. In the autumn the whole plant dies, except the seeds (if it formed them) and the tubers ; and the latter are left disconnected in the ground. Just as that small portion of nourishing matter which is deposited in the seed feeds the embryo when it germinates, so the much larger portion deposited in the tuber nourishes its buds, or eyes, when they likewise grow, the next spring, into new plants. And the great supply enables them to shoot with a greater vigor at the beginning, and to produce a greater amount of vegetation than the seedling plant could do in the same space of time ; which vegetation in turn may prepare and store up, in the course of a few weeks or months, the largest quantity of solid nourishing material, in a form most available for food. Taking advantage of this, man has transported the Potato from the cool Andes of Chili to other cool climates, and makes it yield him a copious supply of food, especially important in countries where the season is too short, or the summer's heat too little, for profitably cultivating the principal grain-plants.

111. The Corm or Solid Bulb, like that of *Cyclamen* (Fig. 103), and of Indian Turnip (Fig. 104), is a very short and thick fleshy subterranean stem, often broader than high. It sends off roots from its lower end, or rather face, leaves and stalks from its upper. The corm of *Cyclamen* goes on to enlarge and to produce a succession of flowers and leaves year after year.

FIG. 101. Tubers of *Helianthus tuberosus*, called "artichokes."

FIG. 102. Bulb-like tubers, such as are occasionally formed on the stem of a Potato-plant above ground.

That of Indian Turnip is formed one year and is consumed the next. Fig. 104 represents it in early summer, having below the corm of last year, from which the roots have fallen. It is partly consumed by the growth of the



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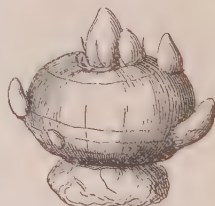


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stem for the season, and the corm of the year is forming at base of the stem above the line of roots.

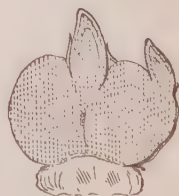
112. The corm of Crocus (Fig. 105, 106), like that of its relative Gladiolus, is also reproduced annually, the new ones forming upon

the summit and sides of the old. Such a corm is like a tuber in budding from the sides, i. e. from the axils of leaves; but these leaves, instead of being small scales, are the sheathing bases of foliage-leaves which covered the surface. It resembles a true bulb in having these sheaths or broad scales; but in the corm or solid bulb, this solid part or stem makes up the principal bulk.



105

113. The Bulb, strictly so-called, is a stem like a reduced corm as to its solid part (or plate); while the main body consists of thickened scales, which are leaves or leaf-bases. These are like bud-scales; so that in fact a bulb is a bud with fleshy scales on an exceedingly short stem. Compare a White Lily bulb (Fig. 107) with the strong scaly buds of the Hickory and Horse-chestnut (Fig. 72 and 73), and the resemblance will appear. In corms, as in tubers and rootstocks, the store of food for future growth is deposited in the stem; while in the bulb, the greater part is deposited in the bases of the leaves, changing them into thick scales, which closely overlap or enclose one another.



106

114. A Scaly Bulb (like that of the Lily, Fig. 107, 108) is one in which the scales are thick but comparatively narrow.

115. A Tunicated or Coated Bulb is one in which the scales enwrap each other, forming concentric coats or layers, as in Hyacinth and Onion.

FIG. 103. Corm of Cyclamen, much reduced in size: roots from lower face, leaf-stalks and flower-stalks from the upper.

FIG. 104. Corm of Indian Turnip (*Arisæma*).

FIG. 105. Corm of a Crocus, the investing sheaths or dead leaf-bases stripped off. The faint cross-lines represent the scars, where the leaves were attached, i. e. the nodes: the spaces between are the internodes. The exhausted corm of the previous year is underneath; forming ones for next year on the summit and sides.

FIG. 106. Section of the same.

116. **Bulblets** are very small bulbs growing out of larger ones; or small bulbs produced above ground on some plants, as in the axils of the leaves of the bulbiferous Lilies of the gardens (Fig. 110), and often in the flower-clusters of the Leek and Onion. They are plainly buds with thickened scales. They never grow into branches, but detach themselves when full grown, fall to the ground, and take root there to form new plants.

117. **Consolidated Vegetation.** An ordinary herb, shrub, or tree is evidently constructed on the plan developing an extensive surface. In fleshy rootstocks,



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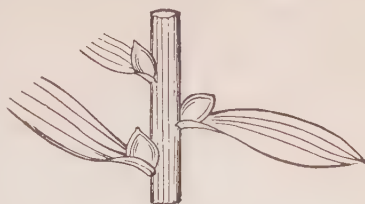


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tubers, corms, and bulbs, the more enduring portion of the plant is concentrated, and reduced for the time of struggle (as against drought, heat, or cold) to a small amount of exposed surface, and this mostly sheltered in the soil. There are many similar consolidated forms which are not subterranean. Thus plants like the Houseleek (Fig. 91) imitate a bulb. Among Cactuses the columnar species of *Cereus* (Fig. 111, *b*), may be likened to rootstocks. A green rind serves the purpose of foliage; but the surface is as nothing compared with an ordinary leafy plant of the same bulk. Compare, for instance, the largest Cactus known, the Giant *Cereus* of the Gila River (Fig. 111, in the background), which rises to the height of fifty or sixty feet, with a common leafy tree of the same height, such as that in Fig. 89, and estimate how vastly greater, even without the foliage, the surface of the latter is than that of the former. Compare, in the



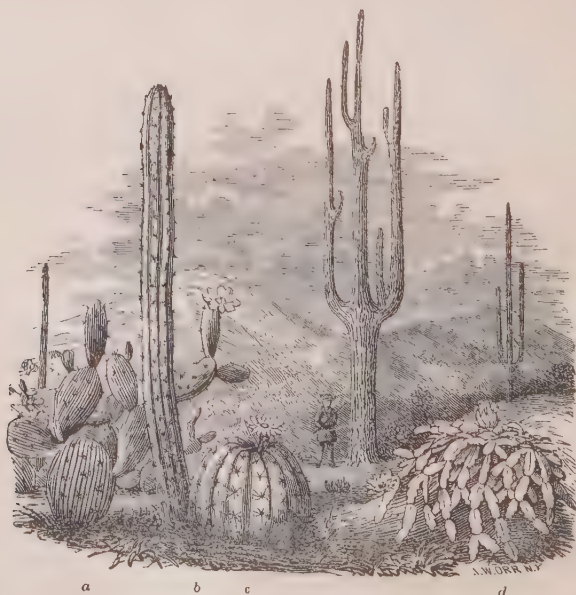
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FIG. 107. Bulb of a wild Lily. 108. The same divided lengthwise, showing two forming buds of the next generation.

FIG. 109. A ground leaf of White Lily, its base (cut across) thickened into a bulb-scale. This plainly shows that bulb-scales are leaves.

FIG. 110. Bulblets in the axils of leaves of a Tiger Lily.

same view, an *Opuntia* or Prickly-Pear Cactus, its stem and branches formed of a succession of thick and flattened joints (Fig. 111, *a*), which may be likened to tubers, or an *Epiphyllum* (*d*), having short and flat joints, with an ordinary leafy shrub or herb of equal size. And finally, in Melon-Cactuses, *Echinocactus* (*c*), or other globose forms (which may be likened to permanent corms), with their globular or bulb-like shapes, we have plants in the compactest shape; their spherical figure being such as to expose the least possible amount of substance to the air. These are adaptations to climates which are very dry, either throughout or for a part of the year. Similarly, bulbous and corm-bearing plants, and the like, are examples of a form of vegetation which in the growing season may expand a large surface to the air and light, while during the period of rest the living vegetable is reduced to a globe, or solid form of the least possible surface; and this protected by its outer coats of dead and dry scales, as well as by its situation under ground. Such are also adapted to a season of drought. They largely belong to countries which have a long hot season of little or no rain, when, their stalks and foliage above and their roots beneath early perishing, the plants rest securely in their compact bulbs, filled with nourishment and retaining their moisture with great tenacity, until the rainy season comes round. Then they shoot forth leaves and flowers with wonderful rapidity, and what was perhaps a desert of arid sand becomes green with foliage and gay with blossoms, almost in a day.

*a**b**c**d*

SECTION VII. LEAVES.

118. STEMS bear leaves, at definite points (nodes, 13); and these are produced in a great variety of forms, and subserve various uses. The commonest kind of leaf, which therefore may be taken as the type or pattern, is an expanded green body, by means of which the plant exposes to the air and light the matters which it imbibes, exhales certain portions, and assimilates the residue into vegetable matter for its nourishment and growth.

119. But the fact is already familiar (10-30) that leaves occur under other forms and serve for other uses, — for the storage of food already assimilated, as in thickened seed-leaves and bulb-scales; for covering, as in bud-scales; and still other uses are to be pointed out. Indeed, sometimes they are of no service to the plant, being reduced to mere scales or rudiments, such as those on the rootstocks of Peppermint (Fig. 97) or the tubers of Jerusalem Artichoke (Fig. 101). These may be said to be of service only to the botanist, in explaining to him the plan upon which a plant is constructed.

120. Accordingly, just as a rootstock, or a tuber, or a tendril is a kind of stem, so a bud-scale, or a bulb-scale, or a cotyledon, or a petal of a flower, is a kind of leaf. Even in respect to ordinary leaves, it is natural to use the word either in a wider or in a narrower sense; as when in one sense we say that a leaf consists of blade and petiole or leaf-stalk, and in another sense say that a leaf is petioled, or that the leaf of *Hepatica* is three-lobed. The connection should make it plain whether by leaf we mean leaf-blade only, or the blade with any other parts it may have. And the student will readily understand that by leaf in its largest or *morphological* sense, the botanist means the organ which occupies the place of a leaf, whatever be its form or its function.

§ 1. LEAVES AS FOLIAGE.

121. This is tautological; for foliage is simply leaves: but it is very convenient to speak of typical leaves, or those which serve the plant for assimilation, as foliage-leaves, or ordinary leaves. These may first be considered.

122. **The Parts of a Leaf.** The ordinary leaf, complete in its parts, consists of *blade*, *foot-stalk*, or *petiole*, and a pair of *stipules*.

123. First the BLADE or LAMINA, which is the essential part of ordinary leaves, that is, of such as serve the purpose of foliage. In structure it consists of a softer part, the *green pulp*, called *parenchyma*, which is traversed and supported by a fibrous frame, the parts of which are called *ribs* or *veins*, on account of a certain likeness in arrangement to the veins of animals.

The whole surface is covered by a transparent skin, the *Epidermis*, not unlike that which covers the surface of all fresh shoots.

124. Note that the leaf-blade expands horizontally, — that is, normally presents its faces one to the sky, the other to the ground, or when the leaf is erect the upper face looks toward the stem that bears it, the lower face away from it. Whenever this is not the case there is something to be explained.

125. The framework consists of *wood*, — a fibrous and tough material which runs from the stem through the leaf-stalk, when there is one, in the form of parallel threads or bundles of fibres; and in the blade these spread out in a horizontal direction, to form the *ribs* and *veins* of the leaf. The stout main branches of the framework are called the *Ribs*. When there is only one, as in Fig. 112, 114, or a middle one decidedly larger than the rest, it is called the *Midrib*. The smaller divisions are termed *Veins*; and their still smaller subdivisions, *Veinlets*. The latter subdivide again and again, until they become so fine that they are invisible to the naked eye. The fibres of which they are composed are hollow; forming tubes by which the sap is brought into the leaves and carried to every part.

126. *Venation* is the name of the mode of veining, that is, of the way in which the veins are distributed in the blade. This is of two principal kinds; namely, the *parallel-veined*, and the *netted-veined*.

127. In *Netted-veined* (also called *Reticulated*) leaves, the veins branch off from the main rib or ribs, divide into finer and finer veinlets, and the branches unite with each other to form meshes of network. That is, they *anastomose*, as anatomists say of the veins and arteries of the body. The Quince-leaf, in Fig. 112, shows this kind of veining in a leaf with a single rib. The Maple, Basswood, Plane or Buttonwood (Fig. 74) show it in leaves of several ribs.

128. In *parallel-veined* leaves, the whole framework consists of slender ribs or veins, which run parallel with each other, or nearly so, from the base to the point of the leaf, — not dividing and subdividing, nor forming meshes, except by minute cross-veinlets. The leaf of any grass, or that of the Lily of the Valley (Fig. 113) will furnish a good illustration. Such parallel veins Linnaeus called *Nerves*, and parallel-veined leaves are still commonly called *nerved* leaves, while those of the other kind are said to be

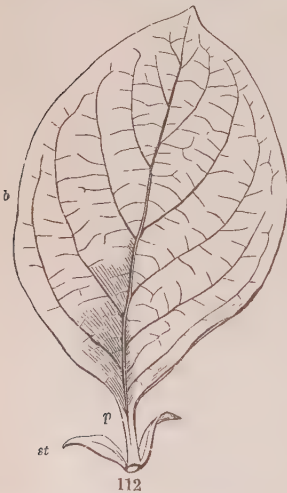


FIG. 112. Leaf of the Quince: *b*, blade; *p*, petiole; *st*, stipules.

veined, — terms which it is convenient to use, although these “nerves” and “veins” are all the same thing, and have no likeness to the *nerves* and little to the *veins* of animals.

129. *Netted-veined* leaves belong to plants which have a pair of seed-leaves or cotyledons, such as the Maple (Fig. 20, 24.), Beech (Fig. 33), and



113



114

the like; while *parallel-veined* or *nerved* leaves belong to plants with one cotyledon or true seed-leaf; such as the Iris (Fig. 59), and Indian Corn (Fig. 70). So that a mere glance at the leaves generally tells what the structure of the embryo is, and refers the plant to one or the other of these two grand classes, — which is a great convenience. For when plants differ from each other in some one important respect, they usually differ correspondingly in other respects also.

130. Parallel-veined leaves are of two sorts, — one kind, and the commonest, having the ribs or nerves all running from the base to the point of the leaf, as in the examples already given; while in another kind they run from a midrib to the margin, as in the common Pickerel-weed of our ponds, in the Banana, in Calla (Fig. 114), and many similar plants of warm climates.

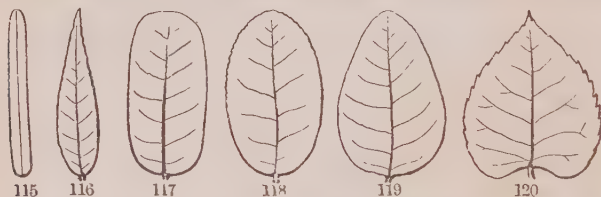
131. Netted-veined leaves are also of two sorts, as in the examples already referred to. In one case the veins all rise from a single rib (the midrib), as in Fig. 112, 116-127. Such leaves are called *Feather-veined* or *Penni-veined*, i. e. *Pinnately-veined*; both terms meaning the same thing, namely, that the veins are arranged on the sides of the rib like the plume of a feather on each side of the shaft.

FIG. 113. A (parallel-veined) leaf of the Lily of the Valley. 114. One of the Calla Lily.

132. In the other case (as in Fig. 74, 129-132), the veins branch off from three, five, seven, or nine ribs, which spread from the top of the leaf-stalk, and run through the blade like the toes of a web-footed bird. Hence these are said to be *Palmately* or *Digitately* veined, or (since the ribs diverge like rays from a centre) *Radiate-veined*.

133. Since the general outline of leaves accords with the frame-work or skeleton, it is plain that *feather-veined* (or *penni-veined*) leaves will incline to elongated shapes, or at least to be longer than broad; while in *radiate-veined* leaves more rounded forms are to be expected. A glance at the following figures shows this.

134. **Forms of Leaves as to General Outline.** It is necessary to give names to the principal shapes, and to define them rather precisely, since they afford easy marks for distinguishing species. The same terms are used



for all other flattened parts as well, such as petals; so that they make up a great part of the descriptive language of Botany. It will be a good exercise for young students to look up leaves answering to these names and definitions. Beginning with the narrower and proceeding to the broadest forms, a leaf is said to be

Linear (Fig. 115), when narrow, several times longer than wide, and of the same breadth throughout.

Lanceolate, or *Lance-shaped*, when conspicuously longer than wide, and tapering upwards (Fig. 116), or both upwards and downwards.

Oblong (Fig. 117), when nearly twice or thrice as long as broad.

Elliptical (Fig. 118) is oblong with a flowing outline, the two ends alike in width.

Oval is the same as broadly elliptical, or elliptical with the breadth considerably more than half the length.

Ovate (Fig. 119), when the outline is like a section of a hen's egg lengthwise, the broader end downward.

Orbicular, or *Rotund* (Fig. 132), circular in outline, or nearly so.

135. A leaf which tapers toward the base instead of toward the apex may be

Ob lanceolate (Fig. 121) when of the lance-shaped form, only more tapering toward the base than in the opposite direction.

Spatulate (Fig. 122) when more rounded above, but tapering thence to a narrow base, like an old-fashioned spatula.

FIG. 115-120. A series of shapes of feather-veined leaves.

Obovate (Fig. 123) or *inversely ovate*, that is, ovate with the narrower end down.

Cuneate or *Cuneiform*, that is, *Wedge-shaped* (Fig. 124), broad above and tapering by nearly straight lines to an acute angle at the base.

136. As to the **Base**, its shape characterizes several forms, such as

Cordate or *Heart-shaped* (Fig.

120, 129), when a leaf of an ovate form, or something like it, has the outline of its rounded base turned in (forming a notch or *sinus*) where the stalk is attached.

Reniform, or *Kidney-shaped* (Fig. 131), like the last, only rounder and broader than long.

Auriculate, or *Eared*, having a pair of small and blunt projections, or

ears, at the base, as in one species of *Magnolia* (Fig. 126).

Sagittate, or *arrow-shaped*, where such ears are acute and turned downwards, while the main body of the blade tapers upwards to a point, as in the common *Sagittaria* or *Arrow-head*, and in the *Arrow-leaved Polygonum* (Fig. 125).

Hastate, or *Halberd-shaped*, when such lobes at the base point outwards, giving the shape of the halberd of the olden time, as in another *Polygonum* (Fig. 127).

Peltate, or *Shield-shaped* (Fig. 132), is the name applied to a curious modification of the leaf, commonly of a rounded form, where the footstalk is attached to the lower surface, instead of the base, and therefore is natu-

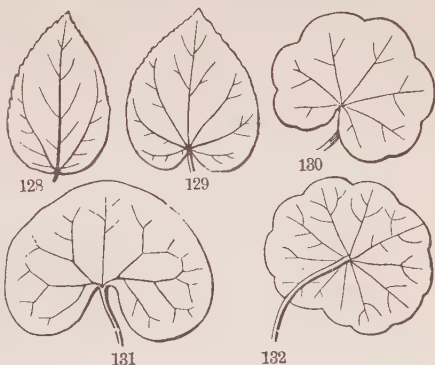
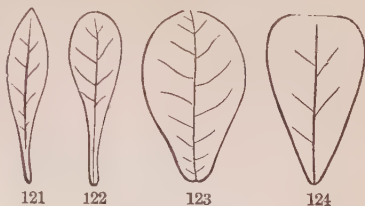


FIG. 121, oblanceolate ; 122, spatulate ; 123, obovate ; and 124, wedge-shaped, feather-veined, leaves.

FIG. 125, sagittate ; 126, auriculate ; and 127, halberd-shaped or hastate leaves.

FIG. 128-132. Various forms of radiate-veined leaves.

rally likened to a shield borne by the outstretched arm. The common Watershield, the Nelumbium, and the White Water-lily, and also the Mandrake, exhibit this sort of leaf. On comparing the shield-shaped leaf of the common Marsh Pennywort (Fig. 132) with that of another common species (Fig. 130), it is at once seen that a shield-shaped leaf is like a kidney-shaped (Fig. 130, 131) or other rounded leaf, with the margins at the base brought together and united.

137. As to the Apex, the following terms express the principal variations:—

Acuminate, *Pointed*, or *Taper-pointed*, when the summit is more or less prolonged into a narrowed or tapering point; as in Fig. 133.

Acute, ending in an acute angle or not prolonged point; Fig. 134.

Obtuse, with a blunt or rounded apex; as in Fig. 135, etc.

Truncate, with the end as if cut off square; as in Fig. 136.

Retuse, with rounded summit slightly indented, forming a very shallow notch, as in Fig. 137.

Emarginate, or *Notched*, indented at the end more decidedly; as in Fig. 138.

Obcordate, that is, inversely heart-shaped, where an obovate leaf is more deeply notched at the end (Fig. 139), as in White Clover and Wood-sorrel; so as to resemble a cordate leaf inverted.

Cuspidate, tipped with a sharp and rigid point; as in Fig. 140.

Mucronate, abruptly tipped with a small and short point, like a mere projection of the midrib; as in Fig. 141.

Aristate, *Awn-pointed*, and *Bristle-pointed*, are terms used when this mucronate point is extended into a longer bristle-form or slender appendage.

The first six of these terms can be applied to the lower as well as to the upper end of a leaf or other organ. The others belong to the apex only.



138. As to degree and nature of Division, there is first of all the difference between

Simple Leaves, those in which the blade is of one piece, however much it may be cut up, and

Compound Leaves, those in which the blade consists of two or more separate pieces, upon a common leaf-stalk or support. Yet between these two kinds every intermediate gradation is to be met with.

139. As to Particular Outlines of Simple Leaves (and the same applies to their separate parts), they are

FIG. 133-141. Forms of the apex of leaves.

Entire, when their general outline is completely filled out, so that the margin is an even line, without teeth or notches.

Serrate, or *Saw-toothed*, when the margin only is cut into sharp teeth, like those of a saw, and pointing forwards: as in Fig. 142.

Dentate, or *Toothed*, when such teeth point outwards, instead of forwards; as in Fig. 143.

Crenate, or *Scalloped*, when the teeth are broad and rounded; as in Fig. 144.

Repand, *Undulate*, or *Wavy*, when the margin of the leaf forms a wavy line, bending slightly in-

wards and outwards in succession; as in Fig. 145.

Sinuate, when the margin is more strongly sinuous or turned inwards and outwards; as in Fig. 146.

Incised, *Cut*, or *Jagged*, when the margin is cut into sharp, deep, and irregular teeth or incisions; as in Fig. 147.

Lobed, when deeply cut. Then the pieces are in a general way called **LOBES**. The number of the lobes is briefly expressed by the phrase *two-lobed*, *three-lobed*, *five-lobed*, *many-lobed*, etc., as the case may be.

140. When the depth and character of the lobing needs to be more particularly specified, the following terms are employed, viz.:—

Lobed, in a special sense, when the incisions do not extend deeper than about half-way between the margin and the centre of the blade, if so far, and are more or less rounded; as in the leaves of the Post-Oak, Fig. 148, and the Hepatica, Fig. 152.

Cleft, when the incisions extend half way down or more, and especially when they are sharp; as in Fig. 149, 153. And the phrases *two-cleft*, or, in the Latin form, *bifid*, *three-cleft* or *trifid*, *four-cleft* or *quadrifid*, *five-cleft* or *quinquefid*, etc., or *many-cleft*, in the Latin form, *multifid*,—express the number of the *Segments*, or portions.

Parted, when the incisions are still deeper, but yet do not quite reach to the midrib or the base of the blade; as in Fig. 150, 154. And the terms *two-parted*, *three-parted*, etc., express the number of such divisions.

Divided, when the incisions extend quite to the midrib, as in the lower part of Fig. 151, or to the leaf-stalk, as in Fig. 155; which really makes the

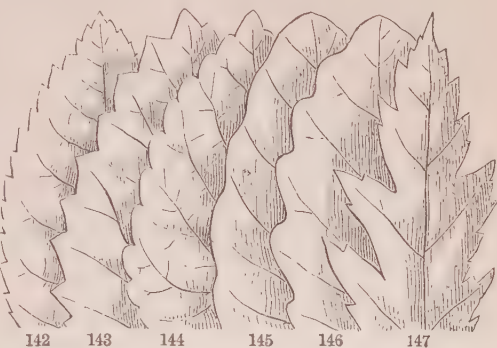


FIG. 142-147. Kinds of margin of leaves.

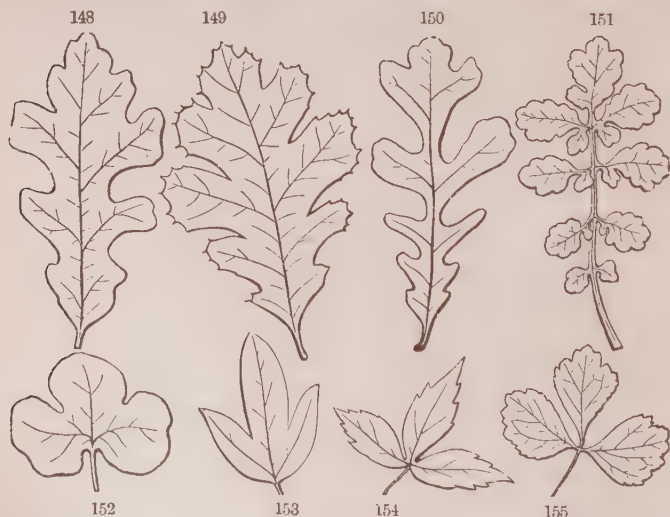
leaf compound. Here, using the Latin form, the leaf is said to be *bisected*, *trisected* (Fig. 155), etc., according to the number of the divisions.

141. The Mode of Lobing or Division corresponds to that of the veining, whether *pinnately veined* or *palmately veined*. In the former the notches or incisions, or *sinuses*, coming between the principal veins or ribs are directed toward the midrib: in the latter they are directed toward the apex of the petiole; as the figures show.

142. So degree and mode of division may be tersely expressed in brief phrases. Thus, in the four upper figures of pinnately veined leaves, the first is said to be *pinnately lobed* (in the special sense), the second *pinnately cleft* (or *pinnatifid* in Latin form), the third *pinnately parted*, the fourth *pinnately divided*, or *pinnatisected*.

143. Correspondingly in the lower row, of palmately veined leaves, the first is *palmately lobed*, the second *palmately cleft*, the third *palmately parted*, the fourth *palmately divided*. Or, in other language of the same meaning (but now less commonly employed), they are said to be *digitately lobed*, *cleft*, *parted*, or *divided*.

144. The number of the divisions or lobes may come into the phrase. Thus in the four last named figures the leaves are respectively *palmately*



three-lobed, *three-cleft* (or *trifid*), *three-parted*, *three-divided*, or better (in Latin form), *trisected*. And so for higher numbers, as *five-lobed*, *five-cleft*,

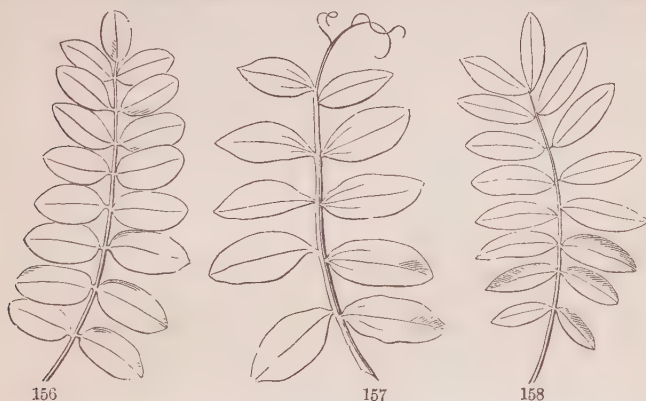
FIG. 148, pinnately lobed; 149, pinnately cleft; 150, pinnately parted; 151, pinnately divided, leaves.

FIG. 152, palmately three-lobed; 153, palmately three-cleft; 154, palmately three-parted; 155, palmately three-divided or trisected, leaves.

etc., up to *many-lobed*, *many-cleft* or *multifid*, etc. The same mode of expression may be used for pinnately lobed leaves, as *pinnately 7-lobed*, *-cleft*, *-parted*, etc.

145. The divisions, lobes, etc., may themselves be *entire* (without teeth or notches), or *serrate*, or otherwise toothed or incised; or lobed, cleft, parted, etc.: in the latter cases making *twice pinnatifid*, *twice palmately* or *pinnately lobed*, *parted*, or *divided* leaves, etc. From these illustrations one will perceive how the botanist, in two or three words, may describe any one of the almost endlessly diversified shapes of leaves, so as to give a clear and definite idea of it.

146. **Compound Leaves.** A compound leaf is one which has its blade in entirely separate parts, each usually with a stalklet of its own; and the stalklet is often *jointed* (or *articulated*) with the main leaf-stalk, just as this



is jointed with the stem. When this is the case, there is no doubt that the leaf is compound. But when the pieces have no stalklets, and are not jointed with the main leaf-stalk, it may be considered either as a divided simple leaf, or a compound leaf, according to the circumstances. This is a matter of names where all intermediate forms may be expected.

147. While the pieces or projecting parts of a simple leaf-blade are called *Lobes*, or in deeply cut leaves, etc., *Segments*, or *Divisions*, the separate pieces or blades of a compound leaf are called **LEAFLETS**.

148. Compound leaves are of two principal kinds, namely, the *Pinnate* and the *Palmate*; answering to the two modes of veining in reticulated leaves, and to the two sorts of lobed or divided leaves (141).

149. *Pinnate* leaves are those in which the leaflets are arranged on the sides of a main leaf-stalk; as in Fig. 156-158. They answer to the

FIG. 156-158. Pinnate leaves, the first with an odd leaflet (*odd-pinnate*); the second with a tendril in place of uppermost leaflets; the third *abruptly pinnate*, or of even pairs.

feather-veined (i. e. *pinnately-veined*) simple leaf; as will be seen at once on comparing the forms. The *leaflets* of the former answer to the *lobes* or *divisions* of the latter; and the continuation of the petiole, along which the leaflets are arranged, answers to the midrib of the simple leaf.

150. Three sorts of pinnate leaves are here given. Fig. 156 is *pinnate with an odd or end leaflet*, as in the Common Locust and the Ash. Fig. 157 is *pinnate with a tendril at the end*, in place of the odd leaflet, as in the Vetches and the Pea. Fig. 158 is *evenly or abruptly pinnate*, as in the Honey-Locust.

151. *Palmate* (also named *Digitate*) leaves are those in which the leaflets are all borne on the tip of the leaf-stalk, as in the Lupine, the Common Clover, the Virginia Creeper (Fig. 93), and the Horse-chestnut and Buckeye (Fig. 159). They evidently answer to the *radiate-veined* or *palmately-veined* simple leaf. That is, the Clover-leaf of three leaflets is the same as a palmately three-ribbed leaf cut into three separate leaflets. And such a simple five-lobed leaf as that of the Sugar-Maple, if more cut, so as to separate the parts,



would produce a palmate leaf of five leaflets, like that of the Horse-chestnut or Buckeye.

152. Either sort of compound leaf may have any number of leaflets; yet palmate leaves cannot well have a great many, since they are all crowded together on the end of the main leaf-stalk. Some Lupines have nine or eleven; the Horse-chestnut has seven, the Sweet Buckeye more commonly five, the Clover three. A pinnate leaf often has only seven or five leaflets, or only three, as in Beans of the genus *Phaseolus*, etc.; in some rarer cases only two; in the Orange and Lemon and also in the common Barberry there is only one! The joint at the place where the leaflet is united with the petiole distinguishes this last case from a simple leaf. In other species of these genera the lateral leaflets also are present.

153. The leaflets of a compound leaf may be either *entire* (as in Fig. 126-128), or *serrate*, or lobed, cleft, parted, etc.; in fact, may present all the variations of simple leaves, and the same terms equally apply to them.

154. When the division is carried so far as to separate what would be one leaflet into two, three, or several, the leaf becomes *doubly* or *twice compound*, either *pinnately* or *palmately*, as the case may be. For example, while the clustered leaves of the Honey-Locust are *simply pinnate*, that is, *once pinnate*, those on new shoots are *bipinnate*, or *twice pinnate*, as in Fig. 160. When these leaflets are again divided in the same way, the leaf

FIG. 159. Palmate (or digitate) leaf of five leaflets, of the Sweet Buckeye.

becomes *thrice pinnate*, or *tripinnate*, as in many Acacias. The first divisions are called *Pinnæ*; the others, *Pinnules*; and the last, or little blades themselves, *Leaflets*.

155. So the palmate leaf, if again compounded in the same way, becomes *twice palmate*, or, as we say when the divisions are in threes, *twice ternate* (in Latin form *biter-nate*); if a third time compounded, *thrice ternate* or *triter-nate*. But if the division goes still further, or if the degree is variable, we simply say that the leaf is *decompound*; either palmately or pinnately decompound, as the case may be. Thus, Fig. 161 represents a four times ternately compound (in other words a *ternately decompound*) leaf of a common Meadow Rue.

156. When the botanist, in describing leaves, wishes to express the number of the leaflets, he may use terms like these:—

Unifoliate, for a compound leaf of a single leaflet; from the Latin *unum*, one, and *foliolum*, leaflet.

Bifoliate, of two leaflets, from the Latin *bis*, twice, and *foliolum*, leaflet.

Trifoliate (or *ternate*), of three leaflets, as the Clover; and so on.

Palmately bifoliate, *trifoliate*, *quadrifoliate*, *plurifoliate* (of several leaflets), etc.: or else

Pinnately bi-, tri-, quadri-, or plurifoliate (that is, of two, three, four, five, or several leaflets), as the case may be: these are terse ways of denoting in single phrases both the number of leaflets and the kind of compounding.

157. Of foliage-leaves having certain peculiarities in structure, the following may be noted:—



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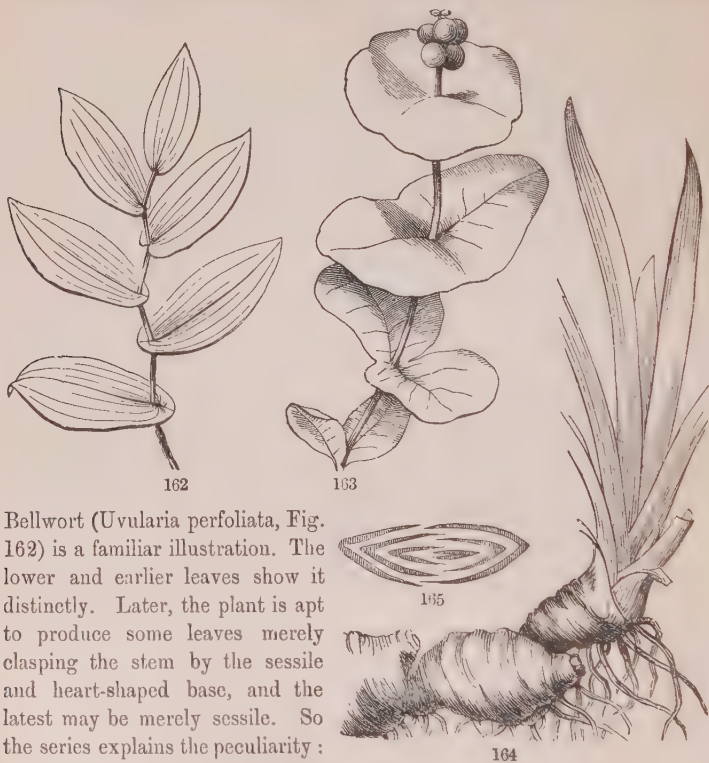


161

FIG. 160. A twice-pinnate (abruptly) leaf of the Honey-Locust.

FIG. 161. Ternately decompound leaf of Meadow Rue.

158. **Perfoliate Leaves.** In these the stem that bears them seems to run through the blade of the leaf, more or less above its base. A common



Bellwort (*Uvularia perfoliata*, Fig. 162) is a familiar illustration. The lower and earlier leaves show it distinctly. Later, the plant is apt to produce some leaves merely clasping the stem by the sessile and heart-shaped base, and the latest may be merely sessile. So the series explains the peculiarity: in the formation of the leaf the bases, meeting around the stem, grow together there.

159. **Connate-perfoliate.** Such are the upper leaves of true Honeysuckles. Here (Fig. 163) of the opposite and sessile leaves, some pairs, especially the uppermost, in the course of their formation unite around the stem, which thus seems to run through the disk formed by their union.

160. **Equitant Leaves.** While ordinary leaves spread horizontally, and present one face to the sky and the other to the earth, there are some that present their tip to the sky, and their faces right and left to the horizon. Among these are the *equitant* leaves of the Iris or Flower-de-Luce. Inspection shows that each leaf was formed as if *folded together lengthwise*,

FIG. 162. A summer branch of *Uvularia perfoliata*; lower leaves perfoliate, upper cordate-clasping, uppermost simply sessile.

FIG. 163. Branch of a Honeysuckle, with connate-perfoliate leaves.

FIG. 164. Rootstock and equitant leaves of Iris. 165. A section across the cluster of leaves at the bottom, showing the equitation.

so that what would be the upper surface is within, and all grown together, except next the bottom, where each leaf covers the next younger one. It was from their straddling over each other, like a man on horseback (as is seen in the cross-section, Fig. 165), that Linnæus, with his lively fancy, called these *Equitant* leaves.

161. **Leaves with no distinction of Petiole and Blade.** The leaves of Iris just mentioned show one form of this. The flat but narrow leaves of Jonquils, Daffodils, and the cylindrical leaf of Onions are other instances. *Needle-shaped* leaves, like those of the Pine, Larch, and Spruce, and the *awl-shaped* as well as the *scale-shaped* leaves of Junipers, Red Cedar, and Arbor-Vitæ (Fig. 166), are examples.

162. **Phyllodia.** Sometimes an expanded *petiole* takes the place of the blade; as in numerous New Holland Acacias, some of which are now common in greenhouses. Such counterfeit blades are called *phyllodia*, — meaning leaf-like bodies. They may be known from true blades by their standing edgewise, their margins being directed upwards and downwards; while in true blades the faces look upwards and downwards; excepting in equitant leaves, as already explained.

163. **Falsely Vertical Leaves.** These are apparent exceptions to the rule, the blade standing edgewise instead of flatwise to the stem; but this position comes



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by a twist of the stalk or the base of the blade. Such leaves present the two faces about equally to the light. The Compass-plant (*Silphium laciniatum*) is an example. So also the leaves of *Boltonia*, of Wild Lettuce, and of a vast number of Australian Myrtaceous shrubs and trees, which much resemble the phyllodia of the Acacias of the same country. They are familiar in *Callistemon*, the Bottle-brush Flower, and in *Eucalyptus*. But in the latter the leaves of the young tree have the normal structure and position.

164. **Cladophylla**, meaning *branch-leaves*. The foliage of *Ruscus* (the Butcher's Broom of Europe) and of *Myrsiphyllum* of South Africa (cultivated for decoration under the false



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FIG. 166. Branch of Arbor-Vitæ, with awl-shaped and scale-shaped leaves.

FIG. 167. The ambiguous leaf? (cladophyllum) of Myrsiphyllum.

FIG. 168. Same of Ruscus, or Butcher's Broom.

name of *Smilax*) is peculiar and puzzling. If these blades (Fig. 167, 168) are really leaves, they are most anomalous in occupying the axil of another leaf, reduced to a little scale. Yet they have an upper and lower face, as leaves should, although they soon twist, so as to stand more or less edge-wise. If they are branches which have assumed exactly the form and office of leaves, they are equally extraordinary in not making any further development. But in *Ruscus*, flowers are borne on one face, in the axil of a little scale: and this would seem to settle that they are branches. In *Asparagus* just the same things as to position are thread-shaped and branch-like.

§ 2. LEAVES OF SPECIAL CONFORMATION AND USE.

165. **Leaves for Storage.** A leaf may at the same time serve both ordinary and special uses. Thus in those leaves of Lilies, such as the common White Lily, which spring from the bulb, the upper and green part



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serves for foliage and elaborates nourishment, while the thickened portion or bud-scale beneath serves for the storage of this nourishment. The thread-shaped leaf of the Onion fulfils the same office, and the nourishing matter it prepares is deposited in its sheathing base, forming one of the concentric layers of the onion. When

these layers, so thick and succulent, have given up their store to the growing parts within, they are left as thin and dry husks. In a Houseleek, an Aloe or an Agave, the green color of the surface of the fleshy leaf indicates that it is doing the work of foliage; the deeper-seated white portion within is the storehouse of the nourishment which the green surface has elaborated. So, also, the seed-leaves or cotyledons are commonly used for storage. Some, as in one of the Maples, the Pea, Horse-chestnut, Oak, etc., are for nothing else. Others, as in Beech and in our common

FIG. 169. A young *Agave Americana*, or Century-plant; fleshy-leaved.

Beans, give faint indications of service as foliage also, chiefly in vain. Still others, as in the Pumpkin and Flax, having served for storage, develop into the first efficient foliage. Compare 11, 22-30, and the accompanying figures.



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166. Leaves as Bud-Scales serve to protect the forming parts within. Having fulfilled this purpose they commonly fall off when the shoot develops and foliage-leaves appear. Occasionally, as in Fig. 170, there is a transition of bud-scales to leaves, which reveals the nature of the former. The Lilac also shows a gradation from bud-scale to simple leaf. In *Cornus florida* (the Flowering Dogwood), the four bud-scales which through the winter protect the head of forming

flowers remain until blossoming, and then the base of each grows out into

FIG. 170. Series of bud-scales and foliage-leaves from a developing bud of the Low Sweet Buckeye (*Æsculus parviflora*), showing nearly complete gradation, from a scale to a compound leaf of five leaflets; and that the scales answer to reduced petioles.

FIG. 171. Shoot of common Barberry, showing transition of foliage-leaves to spines.

a large and very showy petal-like leaf; the original dry scale is apparent in the notch at the apex.

167. Leaves as Spines occur in several plants. A familiar instance is that of the common Barberry (Fig. 171). In almost any summer shoot, most of the gradations may be seen between the ordinary leaves, with sharp bristly teeth, and leaves which are reduced to a branching spine or thorn. The fact that the spines of the Barberry produce a leaf-bud in their axil also proves them to be leaves.



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168. Leaves for Climbing are various in adaptation. True foliage-leaves serve this purpose; as in *Gloriosa*, where the attenuated tip of a simple leaf (otherwise like that of a *Lily*) hooks around a supporting object; or in *Solanum jasminoides* of the gardens (Fig. 172), and in *Maurandia*, etc., where the leaf-stalk coils round and clings to a support; or in the compound leaves of *Clematis* and of *Adlumia*, in which both the leaflets and their stalks hook or coil around the support.

169. Or in a compound leaf, as in the *Pea* and most *Vetches*, and in *Cobæa*, while the lower leaflets serve for foliage, some of the uppermost are developed as tendrils for climbing (Fig. 167). In the common *Pea* this is so with all but one or two pairs of leaflets.

170. In one European *Vetch*, the leaflets are wanting and the whole petiole is a tendril, while the stipules become the only foliage (Fig. 173).

171. Leaves as Pitchers, or hollow tubes, are familiar in the common *Pitcher-plant* or *Side-saddle Flower* (*Sarracenia*, Fig. 174) of our bogs. These pitchers are generally half full of water, in which flies and other insects are drowned, often in such numbers as to make a rich manure for the plant. More curious are some of the southern species of *Sarracenia*, which seem to be specially adapted to the capture and destruction of flies and other insects.

FIG. 172. Leaves of *Solanum jasminoides*, the petiole adapted for climbing.

FIG. 173. Leaf of *Lathyrus Aphaca*, consisting of a pair of stipules and a tendril.

172. The leaf of *Nepenthes* (Fig. 175) combines three structures and uses. The expanded part below is foliage: this tapers into a tendril for



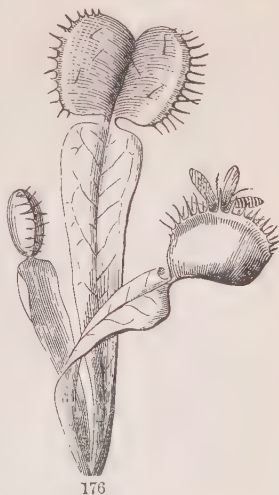
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175

climbing; and this bears a pitcher with a lid. Insects are caught, and perhaps digested, in the pitcher.

173. Leaves as Fly-traps. Insects are caught in another way, and more expertly, by the most extraordinary of all the plants of this country, the *Dionæa* or Venus's Fly-trap, which grows in the sandy bogs around Wilmington, North Carolina. Here (Fig. 176) each leaf bears at its summit an appendage which opens and shuts, in shape something like a steel-trap, and operating much like one. For when open, no sooner does a fly alight on its surface, and brush against any one of the two or three bristles that grow there, than the trap suddenly closes, capturing the intruder. If the fly escapes, the trap soon slowly opens, and is ready for another capture. When retained, the insect is after a time moistened by a secretion from minute glands of the inner surface, and is digested. In the various species of *Drosera* or Sundew, insects are caught



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FIG. 174. Leaf of *Sarracenia purpurea*, entire, and another with the upper part cut off.

FIG. 175. Leaf of *Nepenthes*; foliage, tendril, and pitcher combined.

FIG. 176. Leaves of *Dionæa*; the trap in one of them open, in the others closed.

by sticking fast to very viscid glands at the tip of strong bristles, aided by adjacent gland-tipped bristles which bend slowly toward the captive. The use of such adaptations and operations may be explained in another place.

§ 3. STIPULES.

174. A leaf complete in its parts consists of blade, leaf-stalk or petiole, and a pair of stipules. But most leaves have either fugacious or minute stipules or none at all; many have no petiole (the blade being *sessile* or stalkless); some have no clear distinction of blade and petiole; and many of these, such as those of the Onion and all phyllodia (166), consist of petiole only.

175. The base of the petiole is apt to be broadened and flattened, sometimes into thin margins, sometimes into a sheath which embraces the stem at the point of attachment.



176. Stipules are such appendages, either wholly or partly separated from the petiole. When quite separate they are said to be *free*, as in Fig. 112. When attached to the base of the petiole, as in the Rose and in

FIG. 177. Leaf of Red Clover: *st*, stipules, adhering to the base of *p*, the petiole; *b*, blade of three leaflets.

FIG. 178. Part of stem and leaf of Prince's-Feather (*Polygonum orientale*) with the united sheathing stipules forming a sheath or *ocrea*.

FIG. 179. Terminal winter bud of *Magnolia Umbrella*, natural size. 180. Outermost bud-scale (pair of stipules) detached.

Clover (Fig. 177), they are *adnate*. When the two stipules unite and sheathe the stem above the insertion, as in *Polygonum* (Fig. 178), this sheath is called an *Ocrea*, from its likeness to a greave or leggin.

177. In Grasses, when the sheathing base of the leaf may answer to petiole, the summit of the sheath commonly projects as a thin and short membrane, like an ocrea: this is called a *LIGULA* or *LIGULE*.

178. When stipules are green and leaf-like they act as so much foliage. In the Pea they make up no small part of the actual foliage. In a related plant (*Lathyrus Aphaca*, Fig. 173), they make the whole of it, the remainder of the leaf being tendril.

179. In many trees the stipules are the bud-scales, as in the Beech, and very conspicuously in the Fig-tree, Tulip-tree, and Magnolia (Fig. 179). These fall off as the leaves unfold.

180. The stipules are spines or prickles in Locust and several other Leguminous trees and shrubs; they are tendrils in *Smilax* or Greenbrier.

§ 4. THE ARRANGEMENT OF LEAVES.

181. *Phyllotaxy*, meaning leaf-arrangement, is the study of the position of leaves, or parts answering to leaves, upon the stem.

182. The technical name for the attachment of leaves to the stem is



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the *insertion*. Leaves (as already noticed, 54) are *inserted* in three modes. They are

Alternate (Fig. 181), that is, one after another, or in other words, with only a single leaf to each node;

FIG. 181. Alternate leaves, in Linden, Lime-tree, or Basswood.

FIG. 182. Opposite leaves, in Red Maple.

Opposite (Fig. 182), when there is a pair to each node, the two leaves in this case being always on opposite sides of the stem;

Whorled or Verticillate (Fig. 183) when there are more than two leaves on a node, in which case they divide the circle equally between them, forming a *Verticel* or whorl. When there are three leaves in the whorl, the leaves are one third of the circumference apart; when four, one quarter, and so on. So the plan of opposite leaves, which is very common, is merely that of whorled leaves, with the fewest leaves to the whorl, namely, two.



183. In both modes and in all their modifications, the arrangement is such as to distribute the leaves systematically and in a way to give them a good exposure to the light.

184. No two or more leaves ever grow from the same point. The so-called *Fascicled* or *Clustered* leaves are the leaves of a branch the nodes of which are very close, just as they are in the bud, so keeping the leaves in a cluster. This is evident in the Larch (Fig. 184), in which examination shows each cluster to be made up of numerous leaves crowded on a spur or short axis. In spring there are only such clusters; but in summer some of them lengthen into ordinary shoots with scattered alternate leaves. So, likewise, each cluster of two or three needle-shaped leaves in Pitch Pines (as in Fig. 185), or of five leaves in White Pine, answers to a similar extremely short branch, springing from the axil of a thin and slender scale, which represents a leaf of the main shoot. For Pines produce two kinds of leaves, — 1. primary, the proper leaves of the shoots, not as foliage, but in the shape of delicate scales in spring, which soon fall away; and 2. secondary, the *fascicled* leaves, from buds in the axils of the former, and these form the actual foliage.



Fig. 183. Whorled leaves of *Galium*.

FIG. 184. A piece of stem of Larch with two clusters (fascicles) of numerous leaves.

FIG. 185. Piece of a branch of Pitch Pine, with three leaves in a fascicle or bundle, in the axil of a thin scale which answers to a primary leaf. The bundle is surrounded at the base by a short sheath, formed of the delicate scales of the axillary bud.

185. **Phyllotaxy of Alternate Leaves.** Alternate leaves are distributed along the stem in an order which is uniform for each species. The arrangement in all its modifications is said to be *spiral*, because, if we draw a line from the *insertion* (i. e. the point of attachment) of one leaf to that of the next, and so on, this line will wind spirally around the stem as it rises, and in the same species will always bear the same number of leaves for each turn round the stem. That is, any two successive leaves will always be separated from each other by an equal portion of the circumference of the stem. The distance in *height* between any two leaves may vary greatly, even on the same shoot, for that depends upon the length of the *internodes*, or spaces between the leaves; but the distance as measured around the circumference (in other words, the *Angular Divergence*, or angle formed by any two successive leaves) is uniformly the same.

186. **Two-ranked.** The greatest possible divergence is, of course, where the second leaf stands on exactly the opposite side of the stem from the first, the third on the side opposite the second, and therefore over the first, and the fourth over the second. This brings all the leaves into two ranks, one on one side of the stem and one on the other, and is therefore called the *Two-ranked* arrangement. It occurs in all Grasses, — in Indian Corn, for instance; also, in the Basswood (Fig. 181). This is the simplest of all arrangements, and the one which most widely distributes successive leaves, but which therefore gives the fewest vertical ranks. Next is the

187. **Three-ranked arrangement,** — that of all Sedges, and of White Hellebore. Here the second leaf is placed one third of the way round the stem, the third leaf two thirds of the way round, the fourth leaf accordingly directly over the first, the fifth over the second, and so on. That is, three leaves occur in each turn round the stem, and they are separated from each other by one third of the circumference. (Fig. 186, 187.)

188. **Five-ranked** is the next in the series, and the most common. It is seen in the Apple (Fig. 188), Cherry, Poplar, and the greater number of trees and shrubs. In this case the line traced from leaf to leaf will pass twice round the stem before it reaches a leaf

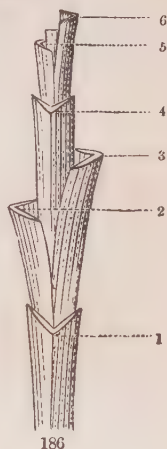


FIG. 186. Two-ranked arrangement, shown in a piece of the stalk of a Sedge, with the leaves cut off above their bases; the leaves are numbered in order, from 1 to 6. 187. Diagram or cross-section of the same, in one plane; the leaves similarly numbered; showing two cycles of three.

situated directly over any below (Fig. 189). Here the sixth leaf is over the first; the leaves stand in five perpendicular ranks, with equal angular distance from each other; and this distance between any two successive leaves is just two fifths of the circumference of the stem.

189. The five-ranked arrangement is expressed by the fraction $\frac{2}{5}$. This



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fraction denotes the divergence of the successive leaves, i. e. the angle they form with each other: the numerator also expresses the number of turns made round the stem by the spiral line in completing one cycle or set of leaves, namely, two; and the denominator gives the number of leaves in each cycle, or the number of perpendicular ranks, namely, five. In the same way the fraction $\frac{1}{2}$ stands for the two-ranked mode, and $\frac{1}{3}$ for the three-ranked: and so these different sorts are expressed by

the series of fractions $\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{5}$. Other cases follow in the same numerical progression, the next being the

190. **Eight-ranked arrangement.** In this the ninth leaf stands over the first, and three turns are made around the stem to reach it; so it is expressed by the fraction $\frac{3}{8}$. This is seen in the Holly, and in the common Plantain. Then comes the

191. **Thirteen-ranked arrangement,** in which the fourteenth leaf is over the first, after five turns around the stem. The common Houseleek (Fig. 191) is a good example.

192. The series so far, then, is $\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{5}$, $\frac{3}{8}$, $\frac{5}{13}$; the numerator and the denominator of each fraction being those of the two next preceding ones added together. At this rate the next higher should be $\frac{8}{21}$, then $\frac{13}{34}$, and so on; and in fact just such cases are met with, and (commonly) no others. These higher sorts are found in the Pine Family, both in the leaves and the cones and in many other plants with small and crowded leaves. But in those the number of the ranks, or of leaves in each cycle, can only rarely

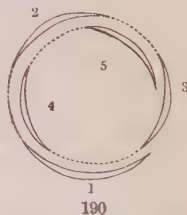
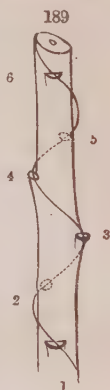


FIG. 188. Shoot with its leaves 5-ranked, the sixth leaf over the first; as in the Apple-tree.

FIG. 189. Diagram of this arrangement, with a spiral line drawn from the attachment of one leaf to the next, and so on; the parts on the side turned from the eye are fainter.

FIG. 190. A ground-plan of the same; the section of the leaves similarly numbered; a dotted line drawn from the edge of one leaf to that of the next marks out the spiral.

be made out by direct inspection. They may be indirectly ascertained, however, by studying the *secondary* spirals, as they are called, which usually become conspicuous, at least two series of them, one turning to the right and one to the left, as shown in Fig. 191. For an account of the way in which the character of the phyllotaxy may be deduced from the secondary spirals, see Structural Botany, Chapter IV.

193. Phyllotaxy of Opposite and whorled Leaves.

This is simple and comparatively uniform. The leaves of each pair or whorl are placed over the intervals between those of the preceding, and therefore under the intervals of the pair or whorl next above. The whorls or pairs alternate or cross each other, usually at right angles, that is, they *decussate*. Opposite leaves, that is, whorls of two leaves only, are far commoner than whorls of three or four or more members. This arrangement in successive decussating pairs gives an advantageous distribution on the stem in four vertical ranks. Whorls of three give six vertical ranks, and so on. Note that in descriptive botany leaves in whorls of two are simply called *opposite* leaves; and that the term *verticillate* or *whorled*, is employed only for cases of more than two, unless the latter number is specified.

194. **Vernation or Præfoliation**, the disposition of the leaf-blades in the bud, comprises two things; 1st, the way in which each separate leaf is folded, coiled, or packed up in the bud; and 2d, the arrangement of the leaves in the bud with respect to one another. The latter of course depends very much upon the phyllotaxy, i. e. the position and order of the leaves upon the stem. The same terms are used for it as for the arrangement of the leaves of the flower in the flower-bud. See, therefore, "*Æstivation, or Præfloration.*"

195. As to each leaf separately, it is sometimes *straight* and open in vernation, but more commonly it is either *bent*, *folded*, or *rolled up*. When the upper part is bent down upon the lower, as the young blade in the Tulip-tree is bent upon the leafstalk, it is said to be *Inflexed* or *Reclined* in vernation. When folded by the midrib so that the two halves are placed face to face, it is *Conduplicate* (Fig. 193), as in the Magnolia, the Cherry, and the Oak. When folded back and forth like the plaits of a fan, it is

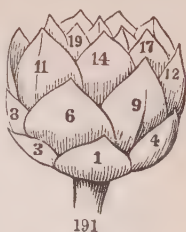


FIG. 191. A young plant of the Houseleek, with the leaves (not yet expanded) numbered, and exhibiting the 13-ranked arrangement; and showing secondary spirals.

FIG. 192. Opposite leaves of Euonymus, or Spindle-tree, showing the successive pairs crossing each other at right angles.

Plicate or *Plaited* (Fig. 194), as in the Maple and Currant. If rolled, it may be so either from the tip downwards, as in Ferns and the Sundew



(Fig. 197), when in unrolling it resembles the head of a crosier, and is said to be *Circinate*; or it may be rolled up parallel with the axis, either from one edge into a coil, when it is *Convolute* (Fig. 195), as in the Apricot and Plum; or rolled from both edges towards the midrib, — sometimes inwards, when it is *Involute* (Fig. 198), as in the Violet and Water - Lily ;

sometimes outwards, when it is *Revolvute* (Fig. 196), in the Rosemary and Azalea. The figures are diagrams, representing sections through the leaf, in the way they were represented by Linnaeus.

SECTION VIII. FLOWERS.

196. Flowers are for the production of seed (16). Stems and branches, which for a time put forth leaves for vegetation, may at length put forth flowers for reproduction.

§ 1. POSITION AND ARRANGEMENT OF FLOWERS, OR INFLORESCENCE.

197. Flower-buds appear just where leaf-buds appear; that is, they are either *terminal* or *axillary* (47-49). Morphologically, flowers answer to shoots or branches, and their parts to leaves.

198. In the same species the flowers are usually from axillary buds only, or from terminal buds only; but in some they are both axillary and terminal.

199. Inflorescence, which is the name used by Linnaeus to signify mode of flower-arrangement, is accordingly of three classes: namely, *Indeterminate*, when the flowers are in the axils of leaves, that is, are from axillary buds; *Determinate*, when they are from terminal buds, and so *terminate* a stem or branch; and *Mixed*, when these two are combined.

200. Indeterminate Inflorescence (likewise, and for the same reason, called *indefinite inflorescence*) is so named because, as the flowers all come from axillary buds, the terminal bud may keep on growing and prolong the stem indefinitely. This is so in Moneywort (Fig. 199).

201. When flowers thus arise singly from the axils of ordinary leaves, they are *axillary* and *solitary*, not collected into flower-clusters.

202. But when several or many flowers are produced near each other, the accompanying leaves are apt to be of smaller size, or of different shape or character: then they are called **BRACTS**, and the flowers thus brought together form a cluster. The kinds of flower-clusters of the indeterminate class have received distinct names, according to their form and disposition. They are principally *Raceme*, *Corymb*, *Umbel*, *Spike*, *Head*, *Spadix*, *Catkin*, and *Panicle*.



203. In defining these it will be necessary to use some of the following terms of descriptive botany which relate to inflorescence. If a flower is stalkless, i. e. sits directly in the axil or other support, it is said to be *sessile*. If raised on a naked stalk of its own (as in Fig. 199) it is *pedunculate*, and the stalk is a **PEDUNCLE**.

204. A peduncle on which a flower-cluster is raised is a *Common peduncle*. That which supports each separate flower of the cluster is a *Partial peduncle*, and is generally called a **PEDICEL**. The portion of the general stalk along which flowers are disposed is called the *Axis of inflorescence*, or, when covered with sessile flowers, the *Rhachis* (back-bone), and sometimes the *Receptacle*. The leaves of a flower-cluster generally are termed **BRACTS**. But when bracts of different orders are to be distinguished, those on the common peduncle or axis, and which have a flower in their axil, keep the name of *bracts*; and those on the pedicels or partial flower-stalks, if any, that of **BRACTLETS** or *Bracteoles*. The former is the preferable English name.

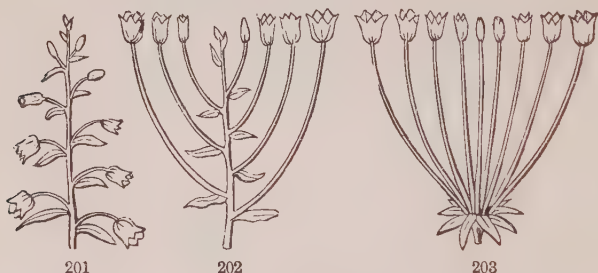
205. A **Raceme** (Fig. 200) is that form of flower-cluster in which the flowers, each on their own foot-stalk or pedicel, are arranged along the sides of a common stalk or axis of inflorescence; as in the Lily of the Valley, Currant, Barberry, one section of Cherry, etc. Each flower comes from the axil of a small leaf, or bract, which, however, is often so small that it might escape notice, and even sometimes (as in the Mustard Family) disappears altogether. The lowest blossoms of a

FIG. 199. Piece of a flowering-stem of Moneywort (*Lysimachia nummularia*), with single flowers successively produced in the axils of the leaves, from below upwards, as the stem grows on.

FIG. 200. A raceme, with a general peduncle (*p*), pedicels (*p'*), bracts (*b*), and bractlets (*b'*). Plainly the bracts here answer to the leaves in Fig. 199.

raceme are of course the oldest, and therefore open first, and the order of blossoming is *ascending* from the bottom to the top. The summit, never being stopped by a terminal flower, may go on to grow, and often does so (as in the common Shepherd's Purse), producing lateral flowers one after another for many weeks.

206. A **Corymb** (Fig. 202) is the same as a raceme, except that it is flat and broad, either convex, or level-topped. That is, a raceme becomes a corymb by lengthening the lower pedicels while the uppermost remain



shorter. The axis of a corymb is short in proportion to the lower pedicels. By extreme shortening of the axis the corymb may be converted into

207. An **Umbel** (Fig. 203) as in the Milkweed, a sort of flower-cluster where the pedicels all spring apparently from the same point, from the top of the peduncle, so as to resemble, when spreading, the rays of an umbrella; whence the name. Here the pedicels are sometimes called the *Rays* of the umbel. And the bracts, when brought in this way into a cluster or circle, form what is called an **INVOLUCRE**.

208. The corymb and the umbel being more or less level-topped, bringing the flowers into a horizontal plane or a convex form, the ascending order of development appears as *Centripetal*. That is, the flowering proceeds from the margin or circumference regularly towards the centre; the lower flowers of the former answering to the outer ones of the latter.

209. In these three kinds of flower-clusters, the flowers are raised on conspicuous *pedicels* (204) or stalks of their own. The shortening of these pedicels, so as to render the flowers *sessile* or nearly so, converts a raceme into a *Spike*, and a corymb or an umbel into a *Head*.

210. A **Spike** is a flower-cluster with a more or less lengthened axis, along which the flowers are sessile or nearly so; as in the Plantain (Fig. 204).

211. A **Head** (*Capitulum*) is a round or roundish cluster of flowers,



204

FIG. 201. A raceme. 202. A corymb. 203. An umbel.

FIG. 204. Spike of the common Plantain or Ribwort.

which are sessile on a very short axis or receptacle, as in the Button-ball, Button-bush (Fig. 205), and Red Clover. It is just what a spike would



205



206

become if its axis were shortened; or an umbel, if its pedicels were all shortened until the flowers became sessile. The head of the Button-bush is naked; but that of the Thistle, of the Dandelion, and the like, is surrounded by empty bracts, which form an *Involucre*. Two particular forms of the spike and the head have received particular names, namely, the *Spadix* and the *Catkin*.

212. A *Spadix* is a fleshy spike or head, with small and often imperfect flowers, as in the Calla, Indian Turnip, (Fig. 206), Sweet Flag, etc. It is commonly surrounded or embraced by a peculiar enveloping leaf, called a *SPATHE*.

213. A *Catkin*, or *Ament*, is the name given to the scaly sort of spike of the Birch (Fig. 207) and Alder, the Willow and Poplar, and one sort of flower-clusters of the Oak, Hickory, and the like, — the so-called *Amen-taceous* trees.

214. *Compound* flower-clusters of these kinds are not uncommon. When the stalks which in the simple umbel are the pedicels of single flowers themselves branch into an umbel, a *Compound Umbel* is formed.



207

FIG. 205. Head of the Button-bush (*Cephalanthus*).

FIG. 206. Spadix and spathe of the Indian Turnip; the latter cut through below.

FIG. 207. Catkin, or Ament, of Birch.

This is the inflorescence of Caraway (Fig. 208), Parsnip, and almost all of the great family of Umbelliferous (umbel-bearing) plants.



208

215. The secondary or partial umbels of a compound umbel are **UMBELLETS**. When the umbellets are subtended by an involucre, this secondary involucre is called an **INVOLUCEL**.

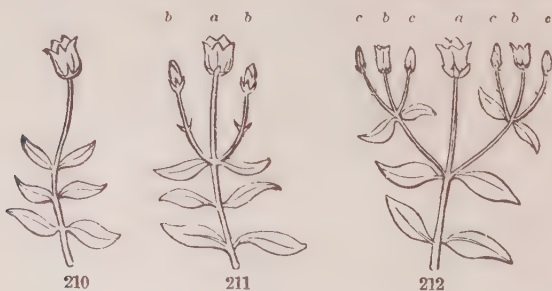
216. A *Compound raceme* is a cluster of racemes racemously arranged, as in *Smilacina racemosa*. A *compound corymb* is a corymb some branches of which branch again in the same way, as in *Mountain Ash*. A *compound spike* is a spicately disposed cluster of spikes.

217. A **Fanicle**, such as that of *Oats* and many *Grasses*, is a compound flower-cluster of a more or less open sort which branches with apparent irregularity, neither into corymbs nor racemes. Fig. 209 represents the simplest panicle. It is, as it were, a raceme of which some of the pedicels have branched so as to bear a few flowers on pedicels of their own, while others remain simple. A *compound panicle* is one that branches in this way again and again.



209

218. **Determinate Inflorescence** is that in which the flowers are from terminal buds. The simplest case is that of a solitary terminal flower, as



210

211

212

in Fig. 210. This stops the growth of the stem; for its terminal bud, becoming a blossom, can no more lengthen in the manner of a leaf-bud. Any

FIG. 208. Compound Umbel of Caraway.

FIG. 209. Diagram of a simple panicle.

FIG. 210. Diagram of an opposite-leaved plant, with a single terminal flower. 211. Same, with a cyme of three flowers; *a*, the first flower, of the main axis; *b b*, those of branches. 212. Same, with flowers also of the third order, *c c*.

further growth must be from axillary buds developing into branches. If such branches are leafy shoots, at length terminated by single blossoms, the inflorescence still consists of solitary flowers at the summit of stem and branches. But if the flowering branches bear only bracts in place of ordinary leaves, the result is the kind of flower-cluster called

219. **A Cyme.** This is commonly a flat-topped or convex flower-cluster, like a corymb, only the blossoms are from terminal buds.

Fig. 211 illustrates the simplest cyme in a plant with opposite leaves, namely, with three flowers. The middle flower, *a*, terminates the stem; the two others, *b b*, terminate branches, one from the axil of each of the uppermost leaves; and being later than the middle one, the flowering proceeds from the centre outwards, or is *Centrifugal*. This is the opposite of the indeterminate mode, or that where all the flower-buds are axillary. If flowering branches appear from the axils below, the lower ones are the later, so that the order of blossoming continues *centrifugal* or, which is the same thing, *descending*, as in Fig. 213, making a sort of reversed raceme or *false raceme*,—a kind of cluster which is to the true raceme just what the flat cyme is to the corymb.



213

220. Wherever there are bracts or leaves, buds may be produced from their axils and appear as flowers. Fig. 212 represents the case where the branches, *b b*, of Fig. 211, each with a pair of small leaves or bracts about their middle, have branched again, and produced the branchlets and flowers *c c*, on each side. It is the continued repetition of this which forms the full or compound cyme, such as that of the *Laurestinus*, *Hobble-bush*, *Dogwood*, and *Hydrangea* (Fig. 214).

221. **A Fascicle** (meaning a bundle), like that of the *Sweet William* and *Lychnis* of the gardens, is only a cyme with the flowers much crowded.

222. **A Glomerule** is a cyme still more compacted, so as to imitate a head. It may be known from a true head by the flowers not expanding centripetally, that is, not from the circumference towards the centre.

223. The illustrations of determinate or *cymose* inflorescence have been taken from plants with opposite leaves, which give rise to the most regular cymes. But the *Rose*, *Cinquefoil*, *Buttercup*, etc., with alternate leaves, furnish also good examples of *cymose* inflorescence.

224. **A Cymule** (or diminutive cyme) is either a reduced small cyme of few flowers, or a branch of a compound cyme, i. e. a partial cyme.

225. **Scorpioid or Helicoid Cymes**, of various sorts, are forms of determinate inflorescence (often puzzling to the student) in which one half of the ramification fails to appear. So that they may be called *incomplete cymes*. The commoner forms may be understood by comparing a complete

FIG. 213. Diagram of a simple cyme in which the axis lengthens, so as to take the form of a raceme.

cyme, like that of Fig. 215 with Fig. 216, the diagram of a cyme of an opposite-leaved plant, having a series of terminal flowers and the axis con-



214

tinued by the development of a branch in the axil of only one of the leaves at each node. The dotted lines on the left indicate the place of the wanting



215

branches, which if present would convert this *scorpioid cyme* into the complete one of Fig. 215. Fig. 217 is a diagram of similar inflorescence with alternate leaves. Both are kinds of *false racemes* (219). When the bracts are also wanting in such cases, as in many Borragineous plants, the true nature of the inflorescence is very much disguised.



216

217

FIG. 214. Compound cyme of *Hydrangea arborescens*, with neutral enlarged flowers round the circumference.

FIG. 215. A complete forking cyme of an *Arenaria*, or Chickweed.

FIG. 216. Diagram of a scorpioid cyme, with opposite leaves or bracts.

FIG. 217. Diagram of analogous scorpioid cyme, with alternate leaves or bracts.

226. These distinctions between determinate and indeterminate inflorescence, between corymbs and cymes, and between the true and the false raceme and spike, were not recognized by botanists much more than half a century ago, and even now are not always attended to in descriptions. It is still usual and convenient to describe rounded or flat-topped and open ramification as *corymbose*, even when essentially cymose; also to call the reversed or false racemes or spikes by these (strictly incorrect) names.

227. **Mixed Inflorescence** is that in which the two plans are mixed or combined in compound clusters. A *mixed panicle* is one in which, while the primary ramification is of the indeterminate order, the secondary or ultimate is wholly or partly of the determinate order. A contracted or elongated inflorescence of this sort is called a **TYRSUS**. Lilac and Horse-chestnut afford common examples of mixed inflorescence of this sort. When loose and open such flower-clusters are called by the general name of *Panicles*. The heads of *Compositæ* are centripetal; but the branches or peduncles which bear the heads are usually of centrifugal order.

§ 2. PARTS OR ORGANS OF THE FLOWER.

228. These were simply indicated in Section II. 16. Some parts are necessary to seed-bearing; these are *Essential Organs*, namely, the *Stamens* and *Pistils*. Others serve for protection or for attraction, often for both. Such are the leaves of the Flower, or the *Floral Envelopes*.

229. **The Floral Envelopes**, taken together, are sometimes called the **PERIANTH**, also *Perigone*, in Latin form *Perigonium*. In a flower which possesses its full number of organs, the floral envelopes are of two kinds, namely, an outer circle, the **CALYX**, and an inner, the **COROLLA**.

230. **The Calyx** is commonly a circle of green or greenish leaves, but not always. It may be the most brightly colored part of the blossom. Each calyx-leaf or piece is called a **SEPAL**.

231. **The Corolla** is the inner circle of floral envelopes or flower-leaves, usually of delicate texture and *colored*, that is, of some other color than green. Each corolla-leaf is called a **PETAL**.

232. There are flowers in abundance which consist wholly of floral envelopes. Such are the so-called full *double flowers*, of which the choicer roses and camellias of the cultivator are familiar examples. In them, under the gardener's care and selection, petals have taken the place of both stamens and pistils. These are monstrous or unnatural flowers, incapable of producing seed, and subservient only to human gratification. Their common name of *double flowers* is not a sensible one: except that it is fixed by custom, it were better to translate their Latin name, *flores pleni*, and call them *full flowers*, meaning full of leaves.

233. Moreover, certain plants regularly produce *neutral flowers*, consisting of floral envelopes only. In Fig. 214, some are seen around the margin

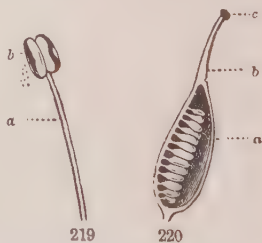
of the cyme in *Hydrangea*. They are likewise familiar in the Hobble-bush and in Wild-Cranberry tree, *Viburnum Oxycoccus*; where they form an attractive setting to the cluster of small and comparatively inconspicuous



perfect flowers which they adorn. In the Guelder Rose, or Snow-ball of ornamental cultivation, all or most of the blossoms of this same shrub are transformed into neutral flowers.

234. The Essential Organs are likewise of two kinds, placed one above or within the other; namely, first, the STAMENS or fertilizing organs, and second, the PISTILS, which are to be fertilized and bear the seeds.

235. A Stamen consists of two parts, namely, the FILAMENT or stalk (Fig. 219 *a*), and the ANTHIER (*b*). The latter is the only essential part. It is a case, commonly with two lobes or cells, each opening lengthwise by a slit, at the proper time, and discharging a powder or dust-like substance, usually of a yellow color. This powder is the POLLEN, or fertilizing matter, to produce which is the office of the stamen.



236. A Pistil (Fig. 220, 221) when complete, has three parts; OVARY, STYLE, and STIGMA. The *Ovary*, at base, is the hollow portion, which contains one or more OVULES or rudimentary seeds. The *Style* is the tapering

FIG. 218. A *flos plenus*, namely, a full double flower of Rose.

FIG. 219. A stamen: *a*, filament: *b*, anther, discharging pollen.

FIG. 220. A pistil; with ovary, *a*, half cut away, to show the contained ovules; *b*, style; *c*, stigma.

portion above: the *Stigma* is a portion of the style, usually its tip, with moist naked surface, upon which grains of pollen may lodge and adhere, and thence make a growth which extends down to the ovules. When there is no style then the stigma occupies the tip of the ovary.

237. The *Torus* or *Receptacle* is the end of the flower-stalk, or the portion of axis or stem out of which the several organs of the flower grow, upon which they are borne (Fig. 223).

238. The parts of the flower are thus disposed on the receptacle or axis essentially as are leaves upon a very short stem; first the sepals, or outer floral leaves; then the petals or inner floral leaves; then the stamens; lastly, at summit or centre, the pistils, when there are two or more of them, or the single pistil, when only one. Fig. 223 shows the organs displayed, two of each kind, of such a simple and symmetrical flower as that of a *Sedum* or *Stonecrop*, Fig. 222.



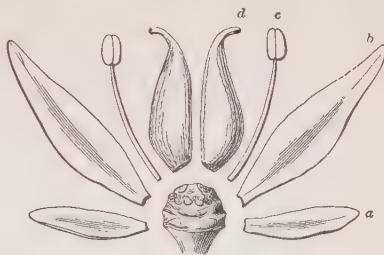
221

§ 3. PLAN OF FLOWER.

239. All flowers are formed upon one general plan, but with almost infinite variations, and many disguises. This common plan is best understood by taking for a type, or standard for comparison, some *perfect*, *complete*,



222



223

regular, and *symmetrical* blossom, and one as simple as such a blossom could well be. Flowers are said to be

Perfect (*hermaphrodite*), when provided with both kinds of essential organs, i. e. with both stamens and pistils.

Complete, when, besides, they have the two sets of floral envelopes, namely,

FIG. 221. Model of a simple pistil, with ovary cut across and slightly opened ventrally, to show the ovules and their attachment.

FIG. 222. Flower of *Sedum ternatum*, a *Stonecrop*.

FIG. 223. Parts of same, two of each kind, separated and displayed; the torus or receptacle in the centre; *a*, a sepal; *b*, a petal; *c*, a stamen; *d*, a pistil.

calyx and corolla. Such are completely furnished with all that belongs to a flower.

Regular, when all the parts of each set are alike in shape and size.

Symmetrical, when there is an equal number of parts in each set or circle of organs.

240. Flax-flowers were taken for a pattern in Section II. 16. But in them the five pistils have their ovaries as it were consolidated into one body.



224



225

Sedum, Fig. 222, has the pistils and all the other parts free from such combination. The flower is perfect, complete, regular, and symmetrical, but is not quite as simple as it might be; for there are twice as many stamens as there are of the other organs. Crassula, a relative of Sedum, cultivated in the conservatories for winter blossoming (Fig. 224) is simpler, being *isostemonous*, or with just as many stamens as petals or sepals, while Sedum is *diplostemonous*, having double that number: it has, indeed, two sets of stamens.

241. **Numerical Plan.** A certain number either runs through the flower or is discernible in some of its parts. This number is most commonly either five or three, not very rarely four, occasionally two. Thus the *ground-plan* of the flowers thus far used for illustration is five. That of Trillium (Fig. 226, 227) is

three, as it likewise is as really, if not as plainly, in Tulips and Lilies, Crocus, Iris, and all that class of blossoms. In some Sedums all the flowers are in fours. In others the first flowers are on the plan of five, the rest mostly on the plan of four, that is, with four sepals, four petals, eight stamens (i. e. twice four), and four pistils. Whatever the ground number may be, it runs through the whole in symmetrical blossoms.



227



226

242. **Alternation of the successive Circles.** In these flowers the parts of the successive circles *alternate*; and such is the rule. That is,

FIG. 224. Flower of a Crassula. 225. Diagram or ground-plan of same.

FIG. 226. Flower of a Trillium; its parts in threes.

FIG. 227. Diagram of flower of Trillium. In this, as in all such diagrams of cross-section of blossoms, the parts of the outer circle represent the calyx; the next, corolla; within, stamens (here in two circles of three each, and the cross-section is through the anthers); in the centre, section of three ovaries joined into a compound one of three cells

the petals stand over the intervals between the sepals; the stamens, when of the same number, stand over the intervals between the petals; or when twice as many, as in the *Trillium*, the outer set alternates with the petals, and the inner set, alternating with the other, of course stands before the petals; and the pistils alternate with these. This is just as it should be on the theory that the circles of the blossom answer to whorls of leaves, which alternate in this way. While in such flowers the circles are to be regarded as whorls, in others they are rather to be regarded as condensed spirals of alternate leaves. But, however this may be, in the mind of a morphological botanist,

243. **Flowers are altered Branches**, and their parts, therefore, altered leaves. That is, certain buds, which might have grown and lengthened into a leafy branch, do, under other circumstances and to accomplish other purposes, develop into blossoms. In these the axis remains short, nearly as it is in the bud; the leaves therefore remain close together in sets or circles; the outer ones, those of the calyx, generally partake more or less of the character of foliage; the next set are more delicate, and form the corolla, while the rest, the stamens and pistils, appear under forms very different from those of ordinary leaves, and are concerned in the production of seed. This view gives to Botany an interest which one who merely notices the shape and counts the parts of blossoms, without understanding their plan, has no conception of.

244. That flowers answer to branches may be shown, first, from their position. As explained in the section on Inflorescence, flowers arise from the same places as branches, and from no other; flower-buds, like leaf-buds, appear either on the summit of a stem, that is, as a terminal bud, or in the axil of a leaf, as an axillary bud. And, as the plan of a symmetrical flower shows, the arrangement of the parts on their axis or receptacle is that of leaves upon the stem.

245. That the sepals and petals are of the nature of leaves is evident from their appearance; they are commonly called the leaves of the flower. The calyx is most generally green in color, and foliaceous (leaf-like) in texture. And though the corolla is rarely green, yet neither are proper leaves always green. In our wild Painted-cup, and in some scarlet Sages, common in gardens, the leaves just under the flowers are of the brightest red or scarlet, often much brighter-colored than the corolla itself. And sometimes (as in many *Cactuses*, and in *Carolina Allspice*) there is such a regular gradation from the last leaves of the plant (bracts or bractlets) into the leaves of the calyx, that it is impossible to say where the one ends and the other begins. If sepals are leaves, so also are petals; for there is no clearly fixed limit between them. Not only in the *Carolina Allspice* and *Cactus* (Fig. 229), but in the *Water-Lily* (Fig. 228) and in a variety of flowers with more than one row of petals, there is such a complete transition between calyx and corolla that no one can surely tell how many of the leaves belong to the one and how many to the other.

246. That stamens are of the same general nature as petals, and therefore a modification of leaves, is shown by the gradual transitions that occur



between the one and the other in many blossoms; especially in cultivated flowers, such as Roses and Camellias, when they begin to *double*, that is, to change their stamens into petals. Some wild and natural flowers show the same interesting transitions. The Carolina Allspice and the White Water-Lily exhibit complete gradations not only between sepals and petals, but

between petals and stamens. The sepals of our Water-Lily are green outside, but white and petal-like on the inside; the petals, in many rows, gradually grow narrower towards the centre of the flower; some of these are tipped with a trace of a yellow anther, but still are petals; the next are more contracted and stamen-like, but with a flat petal-like filament; and a further narrowing of this completes the genuine stamen.

247. Pistils and stamens now and then change into each other in some Willows; pistils often turn into petals in cultivated flowers; and in the Double Cherry they are occasionally replaced by small green leaves. Sometimes a whole blossom changes into a cluster of green leaves, as in the "green roses" occasionally noticed in gardens, and sometimes it degenerates into a leafy branch. So the botanist regards pistils also as answering to leaves; that is, to single leaves when simple and separate, to a whorl of leaves when conjoined.



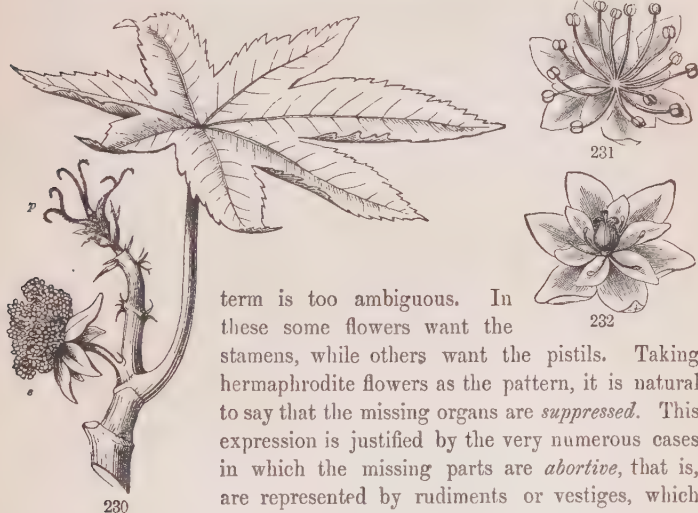
FIG. 228. Series of sepals, petals, and stamens of White Water-Lily, showing the transitions.

FIG. 229. A Cactus blossom.

§ 4. MODIFICATIONS OF THE TYPE.

248. The Deviations, as they may be called, from the assumed type or pattern of flower are most various and extensive. The differences between one species and another of the same genus are comparatively insignificant; those between different genera are more striking; those between different families and classes of plants more and more profound. They represent different adaptations to conditions or modes of life, some of which have obvious or probable utilities, although others are beyond particular explanation. The principal modifications may be conveniently classified. First those which in place of perfect (otherwise called *hermaphrodite* or bisexual) flowers, give origin to

249. Unisexual, or Separated, or Diclinous Flowers, *imperfect* flowers, as they have been called in contradistinction to perfect flowers; but that



to office. Unisexual flowers are

Monœcious (or *Monoïcous*, i. e. of one household), when flowers of both sorts or sexes are produced by the same individual plant, as in the Ricinus or Castor-oil Plant, Fig. 230.

Dicœcious (or *Dioïcous*, i. e. of separate households), when the two kinds are borne on different plants; as in Willows, Poplars, Hemp, and Moonseed, Fig. 231, 232.

Polygamous, when the flowers are some of them perfect, and some staminate or pistillate only.

FIG. 230. Unisexual flowers of Castor-oil plant: s, staminate flower; p, pistillate flower.

FIG. 231, staminate, and 232, pistillate flower of Moonseed.

250. A blossom having stamens and no pistil is a *Staminate* or *Male* flower. Sometimes it is called a *Sterile* flower, not appropriately, for other flowers may equally be sterile. One having pistil but no stamens is a *Pistillate* or *Female* flower.

251. *Incomplete Flowers* are so named in contradistinction to complete: they want either one or both of the floral envelopes. Those of Fig. 230 are incomplete, having calyx but no corolla. So is the flower of *Anemone* (Fig. 233), although its calyx is colored like a corolla. The flowers of *Saururus* or *Lizard's-tail*, although perfect, have neither calyx nor corolla (Fig. 234). Incomplete flowers, accordingly, are

Naked or *Achlamydeous*, destitute of both floral envelopes, as in Fig. 234, or

Apetalous, when wanting only the corolla. The case of corolla present and calyx wholly wanting is extremely rare, although there are seeming instances. In fact, a single or simple perianth is taken to be a calyx, unless the absence or abortion of a calyx can be made evident.

252. In contradistinction to regular and symmetrical, very many flowers are

Irregular, that is, with the members of some or all of the floral circles unequal or dissimilar, and

Unsymmetrical, that is, when the circles of the flower or some of them differ in the number of their members. (Symmetrical and unsymmetrical are used in a different sense in some recent books, but the older use should be adhered to.) Want of numerical symmetry and irregularity commonly go together; and both are common. Indeed, few flowers are entirely

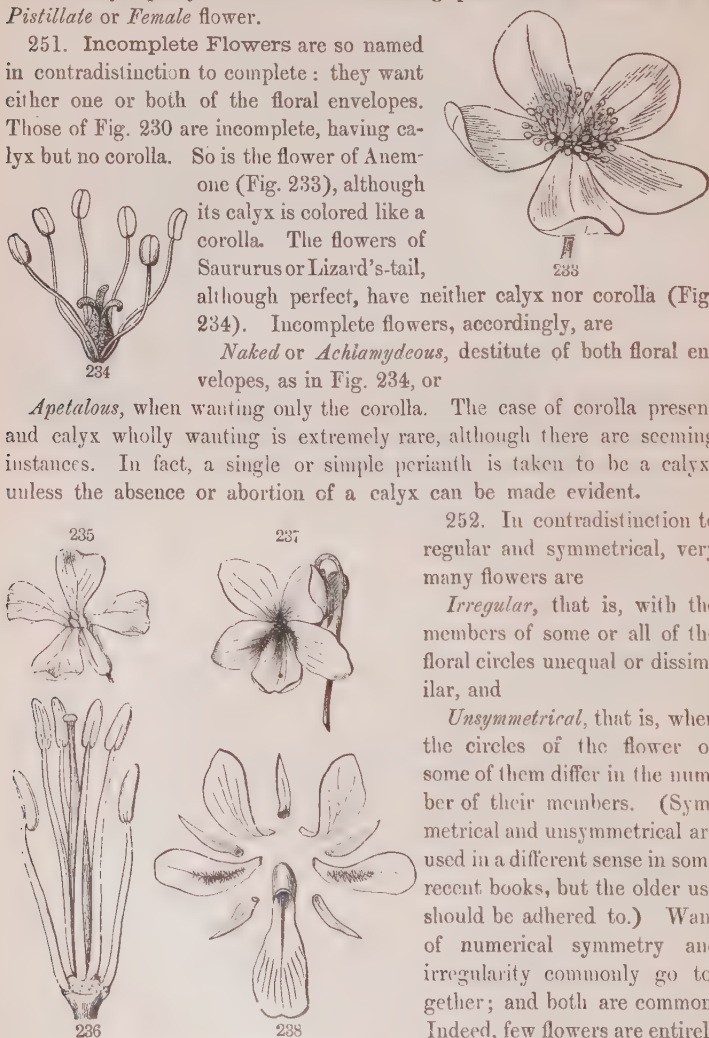


FIG. 233. Flower of *Anemone Pennsylvanica*; apetalous, hermaphrodite.

FIG. 234. Flower of *Saururus* or *Lizard's-tail*; naked, but hermaphrodite.

FIG. 235. Flower of *Mustard*. 236. Its stamens and pistil separate and enlarged.

FIG. 237. Flower of a *Violet*. 238. Its calyx and corolla displayed: the five smaller parts are the sepals; the five intervening larger ones are the petals

symmetrical beyond calyx, corolla, and perhaps stamens; and probably no irregular blossoms are quite symmetrical.

253. Irregular and Unsymmetrical Flowers may therefore be illus-



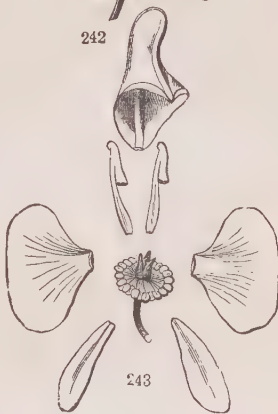
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trated together, beginning with cases which are comparatively free from other complications. The blossom of Mustard, and of all the very natural family which it represents (Fig. 235, 236), is regular but unsymmetrical in the stamens. There are four equal sepals, four equal petals; but six stamens, and only two members in the pistil, which for the present may



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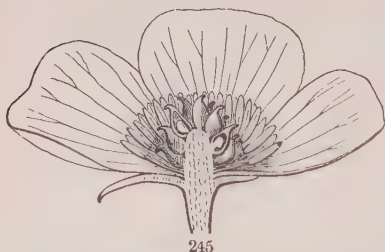
FIG. 239. Flower of a Larkspur. 240. Its calyx and corolla displayed; the five larger parts are the sepals; the four smaller, of two shapes, are the petals; the place of the fifth petal is vacant. 241. Diagram of the same; the place for the missing petal marked by a dotted line.

FIG. 242. Flower of a Monkshood. 243. Its parts displayed; five sepals, the upper forming the hood; the two lateral alike, broad and flat; the two lower small. The two pieces under the hood represent the corolla, reduced to two odd-shaped petals; in centre the numerous stamens and three pistils. 244. Diagram of the calyx and corolla; the three dotted lines in the place of missing petals.

be left out of view. The want of symmetry is in the stamens. These are in two circles, an outer and an inner. The outer circle consists of two stamens only; the inner has its proper number of four. The flower of Violet, which is on the plan of five, is symmetrical in calyx, corolla, and stamens, inasmuch as each of these circles consists of five members; but it is conspicuously irregular in the corolla, one of the petals being very different from the rest.

254. The flowers of Larkspur, and of Monkshood or Aconite, which are nearly related, are both strikingly irregular in calyx and corolla, and considerably unsymmetrical. In Larkspur (Fig. 239-241) the irregular calyx consists of five sepals, one of which, larger than the rest, is prolonged behind into a large sac or spur; but the corolla is of only four petals (of two shapes), — the fifth, needed to complete the symmetry, being left out. And the Monkshood (Fig. 242-244) has five very dissimilar sepals, and a corolla of only two very small and curiously-shaped petals, — the three needed to make up the symmetry being left out. The stamens in both are out of symmetry with the ground-plan, being numerous. So are the pistils, which are usually diminished to three, sometimes to two or to one.

255. Flowers with Multiplication of Parts are very common. The stamens are indefinitely numerous in Larkspur and in Monkshood (Fig. 242, 243), while the pistils are fewer than the ground-plan suggests. Most Cactus-flowers have all the organs much increased in number (Fig. 229), and so of the Water-Lily. In Anemone (Fig. 233) the stamens and pistils are multiplied while



the petals are left out. In Buttercups or Crowfoot, while the sepals and petals conform to the ground-plan of five, both stamens and pistils are indefinitely multiplied (Fig. 245).

256. Flowers modified by Union of Parts, so that these parts more or less lose the appearance of separate leaves or other organs growing out of the end of the stem or receptacle, are extremely common. There are two kinds of such union, namely: —

Coalescence of parts of the same circle by their contiguous margins; and *Adnation*, or the union of adjacent circles or unlike parts.

257. Coalescence is not rare in leaves, as in the upper pairs of Honey-suckles, Fig. 163. It may all the more be expected in the crowded circles or whorls of flower-leaves. Datura or Stramonium (Fig. 246) shows this coalescence both in calyx and corolla, the five sepals and the five petals being thus united to near their tips, each into a tube or long and narrow cup. These unions make needful the following terms: —

FIG. 245. Flower of *Ranunculus bulbosus*, or Buttercup, in section.

Gamopetalous, said of a corolla the petals of which are thus coalescent into one body, whether only at base or higher. The union may extend to the very summit, as in Morning Glory and the like (Fig. 247), so that the number of petals in it may not be apparent. The old name for this was *Monopetalous*, but that means "one-petalled;" while gamopetalous means "petals united," and therefore is the proper term.

Polypetalous is the counterpart term, to denote a corolla of *distinct*, that is, separate petals. As it means "many petalled," it is not the best possible name, but it is the old one and in almost universal use.

Gamosepalous applies to the calyx when the sepals are in this way united.

Polysepalous, to the calyx when of separate sepals or calyx-leaves.

258. Degree of union or of separation in descriptive botany is expressed in the same way as is the lobing of leaves (139). See Fig. 249-253, and the explanations.

259. A corolla when gamopetalous commonly shows a distinction (well marked in Fig. 249-251) between a contracted tubular portion below, the **TUBE**, and the spreading part above, the **BORDER** or **LIMB**. The junction between tube and limb, or a more or less enlarged upper portion of the tube between the two, is the **THROAT**. The same is true of the calyx.

260. Some names are given to particular forms of the gamopetalous corolla, applicable also to a gamosepalous calyx, such as

Wheel-shaped, or *Rotate*; when spreading out at once, without a tube or with a very short one, something in the shape of a wheel or of its diverging spokes, Fig. 252, 253.

Salver-shaped, or *Salverform*; when a flat-spreading border is raised on



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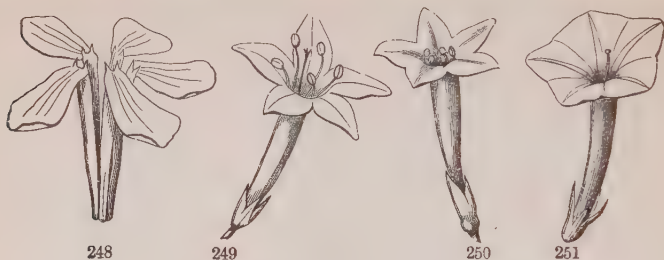


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FIG. 246. Flower of *Datura Stramonium*; gamosepalous and gamopetalous.

FIG. 247. Funnel-form corolla of a common Morning Glory, detached from its polysepalous calyx.

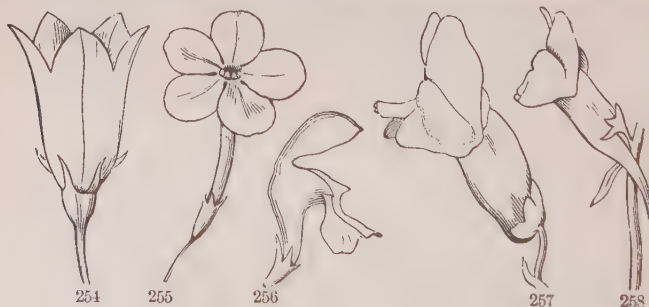
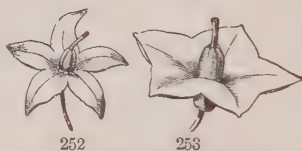
a narrow tube, from which it diverges at right angles, like the salver rep-



resented in old pictures, with a slender handle beneath, Fig. 249-251, 255.

Bell-shaped, or Campanulate; where a short and broad tube widens upward, in the shape of a bell, as in Fig. 254.

Funnel-shaped, or Funnel-form; gradually spreading at the summit of a tube which is narrow below, in the



shape of a funnel or tunnel, as in the corolla of the common Morning Glory (Fig. 247) and of the Stramonium (Fig. 246).

FIG. 248. Polypetalous corolla of Soapwort, of five petals with long claws or stalk-like bases.

FIG. 249. Flower of Standing Cypress (*Gilia coronopifolia*); gamopetalous: the tube answering to the long claws in 248, except that they are coalescent: the limb or border (the spreading part above) is *five-parted*, that is, the petals not there united except at very base.

FIG. 250. Flower of Cypress-vine (*Ipomœa Quamoclit*); like preceding, but limb *five-lobed*.

FIG. 251. Flower of *Ipomœa coccinea*; limb almost *entire*.

FIG. 252. Wheel-shaped or rotate and five-parted corolla of Bittersweet, *Solanum Dulcamara*. 253. Wheel-shaped and five-lobed corolla of Potato.

FIG. 254. Flower of a Campanula or Harebell, with a campanulate or bell-shaped corolla; 255, of a Phlox, with salver-shaped corolla; 256, of Dead-Nettle (*Lamium*), with labiate *ringent* (or gaping) corolla; 257, of Snapdragon, with labiate *personate* corolla; 258, of Toad-Flax, with a similar corolla spurred at the base.

Tabular; when prolonged into a tube, with little or no spreading at the border, as in the corolla of the Trumpet Honeysuckle, the calyx of *Stramonium* (Fig. 246), etc.

261. Although sepals and petals are usually all blade or lamina (123), like a sessile leaf, yet they may have a contracted and stalk-like base, answering to petiole. This is called its **CLAW**, in Latin *Unguis*. *Unguiculate* petals are universal and strongly marked in the Pink tribe, as in Soapwort (Fig. 248).

262. Such petals, and various others, may have an outgrowth of the inner

face into an appendage or fringe, as in Soapwort, and in *Silene* (Fig. 259), where it is at the junction of claw and blade. This is called a **CROWN**, or *Corona*. In *Passion-flowers* (Fig. 260) the crown consists of numerous threads on the base of each petal.

263. **Irregular Flowers** may be polypetalous, or nearly so, as in the papilionaceous corolla; but most of them are irregular through coalescence, which often much disguises the numerical symmetry also. As affecting the corolla the following forms have received particular names:

264. **Papilionaceous Corolla**, Fig. 261, 262. This is polypetalous, except that two of the petals cohere, usually but slightly. It belongs only to the Leguminous or Pulse family. The name means butterfly-like; but the likeness is hardly obvious. The names of the five petals of the *papilionaceous* corolla are curiously incongruous. They are,

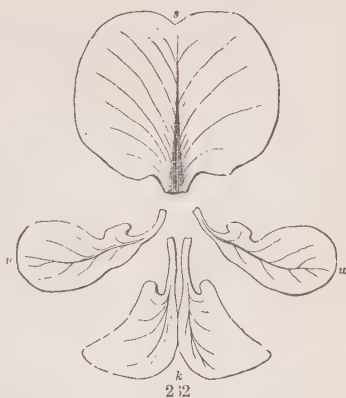
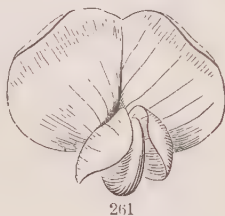
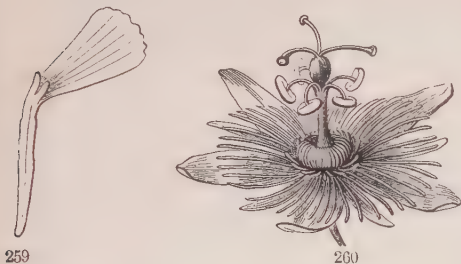


FIG. 259. Unguiculate (clawed) petal of a *Silene*; with a two-parted crown.

FIG. 260. A small *Passion-flower*, with crown of slender threads.

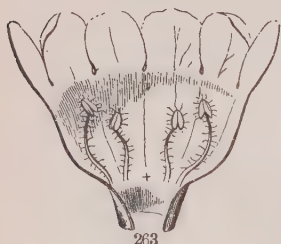
FIG. 261. Front view of a papilionaceous corolla. 262. The parts of the same, displayed: *s*, Standard, or Vexillum; *w*, Wings, or Alæ; *k*, Keel, or Carina.

The **STANDARD** or *Banner* (*Vexillum*), the large upper petal which is external in the bud and wrapped around the others.

The **WINGS** (*Alæ*), the pair of side petals, of quite different shape from the standard.

The **KEEL** (*Carina*), the two lower and usually smallest petals; these are lightly coalescent into a body which bears some likeness, not to the keel, but to the prow of a boat; and this encloses the stamens and pistil. A Pea-blossom is a typical example; the present illustration is from a species of Locust, *Robinia hispida*.

265. **Labiæ Corolla** (Fig. 256-258), which would more properly have been called *Bilabiate*, that is, two-lipped.



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This is a common form of gamopetalous corolla; and the calyx is often bilabiate also. These flowers are all on the plan of five; and the irregularity in the corolla is owing to unequal union of the petals as well as to diversity of form. The two petals of the upper or posterior side of the flower unite with each other higher up than with the lateral petals (in Fig. 256, quite to the top), forming the *Upper lip*: the lateral and the lower similarly unite to form the *Lower lip*. The single notch which is generally found at the summit of the upper lip, and the two notches of the lower lip, or in other words the two lobes of the upper and the three of the lower lip, reveal the real composition. So also does the alternation of these five parts with those of the calyx outside. When the calyx is also bilabiate, as in the Sage, this alternation gives three lobes or sepals to the upper and two to the lower lip. Two forms of the labiate corolla have been designated, viz.:—

Ringent or *Gaping*, when the orifice is wide open, as in Fig. 256.

Personate or *Masked*, when a protuberance or intrusion of the base of the lower lip (called a *Palate*) projects over or closes the orifice, as in Snapdragon and Toad-Flax, Fig. 257, 258.

FIG. 263. Corolla of a purple *Gerardia* laid open, showing the four stamens; the cross shows where the fifth stamen would be, if present.

FIG. 264. Corolla, laid open, and stamens of *Pentstemon grandiflorus*, with a sterile filament in the place of the fifth stamen, and representing it.

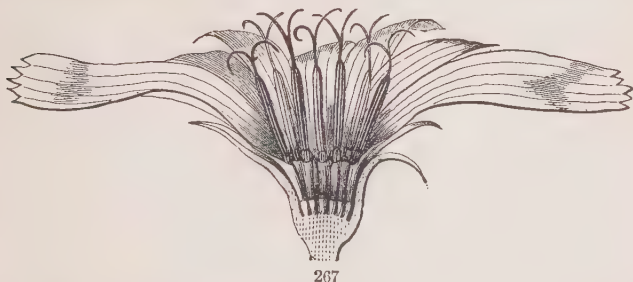
FIG. 265. Corolla of *Catalpa* laid open, displaying two good stamens and three abortive ones or vestiges.

266. There are all gradations between labiate and regular corollas. In those of *Gerardia*, of some species of *Pentstemon*, and of *Catalpa* (Fig. 263–265), the labiate character is slight, but is manifest on close inspection. In almost all such flowers the plan of five, which is obvious or ascertainable in the calyx and corolla, is obscured in the stamens by the abortion or suppression of one or three of their number.

267. **Ligulate Corolla.** The ligulate or *Strap-shaped* corolla mainly belongs to the family of *Compositæ*, in which numerous small flowers are



gathered into a head, within an involucre that imitates a calyx. It is best exemplified in the Dandelion and in Chicory (Fig. 266). Each one of these straps or *Ligules*, looking like so many petals, is the corolla of a dis-



tinct flower: the base is a short tube, which opens out into the ligule: the five minute teeth at the end indicate the number of constituent petals. So this is a kind of gamopetalous corolla, which is open along one side nearly

FIG. 266. Two flower-heads of Chicory.

FIG. 267. One of them half cut away, better showing some of the flowers.

to the base, and outspread. The nature of such a corolla (and of the stamens also, to be explained in the next section) is illustrated by the flower of a *Lobelia*, Fig. 285.

268. In *Asters*, *Daisies*, *Sunflower*, *Coreopsis* (Fig. 268), and the like, only the marginal (or *Ray*) corollas are ligulate; the rest (those of the *Disk*) are regularly gamopetalous, tubular, and five-lobed at summit; but they are small and individually inconspicuous, only the *ray-flowers* making a show. In fact, those of *Coreopsis* and of *Sunflower* are simply for show, these *ray-flowers* being not only sterile, but *neutral*, that is, having neither stamens nor pistil. But in *Asters*, *Daisies*, *Golden-rods*, and the like, these *ray-flowers* are pistillate and fertile, serving



therefore for seed-bearing as well as for show. Let it not be supposed that the show is useless. See Section XIII.

269. *Adnation*, or *Consolidation*, is the union of the members of parts belonging to different circles of the flower (256). It is of course understood that in this (as likewise in *coalescence*) the parts are not formed and then conjoined, but are produced in union. They are born united, as the term *adnate* implies. To illustrate this kind of union, take the accompanying series of flowers (Fig. 270-274), shown in vertical section. In the first, Fig. 270, *Flax-flower*, there is no adnation; sepals, petals, and stamens, are *free* as well as distinct, being separately borne on the receptacle, one circle within or above the next; only the five pistils have their ovaries coalescent. In Fig. 271, a *Cherry flower*, the petals and stamens are borne on the throat of the calyx-tube; that is, the sepals are coalescent into a cup, and the petals and stamens are *adnate* to the inner face of this; in other

FIG. 268. Head of flowers of a *Coreopsis*, divided lengthwise.

FIG. 269. A slice of the preceding more enlarged, with one tubular perfect flower (*a*) left standing on the receptacle, with its bractlet or chaff (*b*), one ligulate and neutral ray-flower (*c*), and part of another; *dd*, section of bracts or leaves of the involucre.

words, the sepals, petals, and stamens are all consolidated up to a certain height. In Fig. 272, a Purslane-flower, the same parts are adnate to or consolidated with the ovary up to its middle. In Fig. 273, a Hawthorn-flower, the consolidation has extended over the whole ovary; and petals and stamens are adnate to the calyx still further. In Fig. 274, a Cranberry-blossom, it is the same except that all the parts are free at the same height; all seem to arise from the top of the ovary.

270. In botanical description, to express tersely such differences in the relation of these organs to the pistil, they are said to be

Hypogynous (i. e. under the pistil) when they are all *free*, that is, not adnate to pistil nor connate with each other, as in Fig. 270.

Perigynous (around the pistil) when connate with each other, that is, when petals and stamens are *inserted* or borne on the calyx, whether as in Cherry-flowers (Fig. 271) they are free from the pistil, or as in Purslane and Hawthorn (Fig. 272, 273) they are also adnate below to the ovary.

Epigynous (on the ovary) when so adnate that all these parts appear to arise from the very summit of the ovary, as in Fig. 274. The last two terms are not very definitely distinguished.

271. Another and a simpler form of expression is to describe parts of the flower as being

Free, when not united with or *inserted* upon other parts.

Distinct, when parts of the same kind are not united. This term is the counterpart of coalescent, as free is the counterpart of adnate. Many writers use the term "free" indiscriminately for both; but it is better to distinguish them.

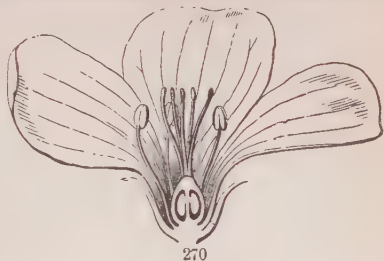


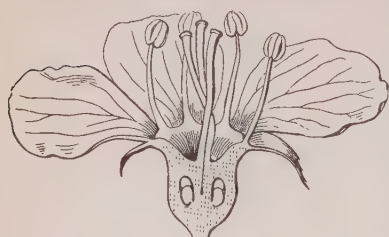
FIG. 270 Flax-flower in section; the parts all free, — hypogynous.

FIG. 271. Cherry-flower in section; petals and stamens adnate to tube of calyx, — perigynous.

FIG. 272. Purslane-flower in section; calyx, petals, stamens, all adnate to lower half of ovary, — epigynous.

Connate is a term common for either not free or not distinct, that is, for parts united congenitally, whether of same or of different kinds.

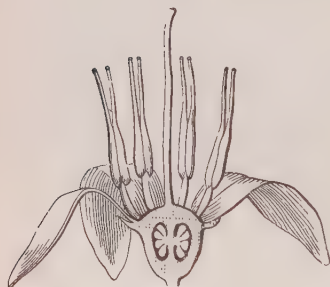
Adnate, as properly used, relates to the union of dissimilar parts.



272. In still another form of expression, the terms superior and inferior have been much used in the sense of above and below.

Superior is said of the ovary of Flax-flower, Cherry, etc., because above the other parts; it is equivalent to "ovary free." Or it is said of the calyx, etc., when above the ovary, as in Fig. 273-275.

Inferior, when applied to the ovary, means the same as "calyx adnate;" when applied to the floral envelopes, it means that they are free.



273. **Position of Flower or of its Parts.** The terms superior and inferior, or upper and lower, are also used to indicate the relative position of the parts of a flower in reference to the axis of inflorescence.

cence. An axillary flower stands between the bract or leaf which subtends it and the axis or stem which bears this bract or leaf. This is represented in sectional diagrams (as in Fig. 275, 276) by a transverse line for the bract, and a small circle for the axis of inflorescence. Now the side of the blossom which faces the bract is the



Anterior, or *Inferior*, or *Lower* side; while the side next the axis is the



Posterior, or *Superior*, or *Upper* side of the flower.

274. So, in the labiate corolla (Fig. 256-258), the lip which is composed of three of the five petals is the *anterior*, or *inferior*, or *lower* lip; the other is the *posterior*, or *superior*, or *upper* lip.

FIG. 273. Hawthorn-blossom in section; parts adnate to whole face of ovary, and with each other beyond; another grade of perigynous.

FIG. 274. Cranberry-blossom in section; parts epigynous.

FIG. 275. Diagram of papilionaceous flower (Robinia, Fig. 261), with bract below; axis of inflorescence above.

FIG. 276. Diagram of Violet-flower; showing the relation of parts to bract and axis.

275. In Violets (Fig. 238, 276), the odd sepal is posterior (next the axis); the odd petal is therefore anterior, or next the subtending leaf. In the papilionaceous flower (Fig. 261, and diagram, Fig. 275), the odd sepal is anterior, and so two sepals are posterior; consequently, by the alternation, the odd petal (the standard) is posterior or upper, and the two petals forming the keel are anterior or lower.

§ 5. ARRANGEMENT OF PARTS IN THE BUD.

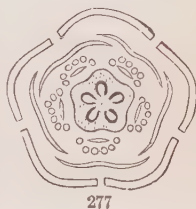
276. *Æstivation* was the fanciful name given by Linnæus to denote the disposition of the parts, especially the leaves of the flower, before *Anthesis*, i. e. before the blossom opens. *Præfloration*, a better term, is sometimes used. This is of importance in distinguishing different families or genera of plants, being generally uniform in each. The æstivation is best seen by making a slice across the flower-bud; and it may be expressed in diagrams, as in the accompanying figures.

277. The pieces of the calyx or the corolla either overlap each other in the bud, or they do not. When they do not overlap, the æstivation is

Valvate, when the pieces meet each other by their abrupt edges, without any infolding or overlapping; as the calyx of the Linden or Basswood (Fig. 277).

Induplicate, which is valvate with the margins of each piece projecting inwards, as in the calyx of a common Virgin's-bower, Fig. 278, or

Involute, which is the same but the margins rolled inward, as in most of the large-flowered species of Clematis, Fig. 279.



Reduplicate, a rarer modification of valvate, is similar but with margins projecting outward.

Open, the parts not touching in the bud, as the calyx of Mignonette.

278. When the pieces overlap in the bud, it is in one of two ways; either every piece has one edge in and one edge out, or some pieces are wholly outside and others wholly inside. In

the first case the æstivation is

Convolute, also named *Contorted* or *Twisted*, as in Fig. 280, a cross-section of a corolla very strongly thus convolute or rolled up together, and in the corolla of a Flax-flower (Fig. 281), where the petals only moderately overlap in this way. Here one edge of every petal covers the next before

FIG. 277. Diagram of a flower of Linden, showing the calyx valvate and corolla imbricate in the bud, etc.

FIG. 278. Valvate-induplicate æstivation of calyx of common Virgin's-bower.

FIG. 279. Valvate-involute æstivation of same in Vine-bower, Clematis Vitalba.

it, while its other edge is covered by the next behind it. The other mode is the

Imbricate or *Imbricated*, in which the outer parts cover or overlap the inner so as to "break joints," like tiles or shingles on a roof; whence the name. When the parts are three, the first or outermost is wholly external, the third wholly internal, the second has one margin covered by the first while the other overlaps the third or innermost



280



281

piece: this is the arrangement of alternate three-ranked leaves (187). When there are five pieces, as in the corolla of Fig. 225, and calyx of Fig. 281, as also of Fig. 241, 276, two are external, two are internal, and one (the third in the spiral) has one edge covered by the outermost, while its other edge covers the innermost; which is just the five-ranked arrangement of alternate leaves (188). When the pieces are four, two are outer and two are inner; which answers to the arrangement of opposite leaves.



279. The imbricate and the convolute modes sometimes vary one into the other, especially in the corolla.

280. In a gamopetalous corolla or gamosepalous calyx, the shape of the tube in the bud may sometimes be noticeable. It may be



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Plicate or *Plaited*, that is, folded lengthwise; and the plaits may either be turned outwards, forming projecting ridges, as in the corolla of *Campanula*; or turned inwards, as in that of *Gentian Belladonna*; or

Supervolute, when the plaits are convolutely wrapped round each other, as in the corolla of *Morning Glory* and of *Stramonium*, Fig. 282.

SECTION IX. STAMENS IN PARTICULAR.

281. *Andræcium* is a technical name for the staminate system of a flower (that is, for the stamens taken together), which it is sometimes convenient to use. The preceding section has dealt with modifications of the flower pertaining mainly to calyx and corolla. Those relating to the stamens are now to be indicated. First as to

FIG. 280. Convolute aestivation, as in the corolla-lobes of *Oleander*.

FIG. 281. Diagram of a *Flax*-flower; calyx imbricated and corolla convolute in the bud.

FIG. 282. Upper part of corolla of *Datura Stramonium* in the bud; and below a section showing the convolution of the plaits.

282. **Insertion**, or place of attachment. The stamens usually go with the petals. Not rarely they are at base

Epipetalous, that is, inserted on (or adnate to) the corolla, as in Fig. 283. When free from the corolla, they may be

Hypogynous, inserted on the receptacle under the pistil or gynæcium.

Perigynous, inserted on the calyx, that is, with the lower part of filament adnate to the calyx-tube.

Epigynous, borne apparently on the top of the ovary; all which is explained in Fig. 270-274.

Gynandrous is another term relating to insertion of rarer occurrence, that is, where the stamens are inserted on (in other words, adnate to) the style, as in Lady's Slipper (Fig. 284), and in the Orchis family generally.

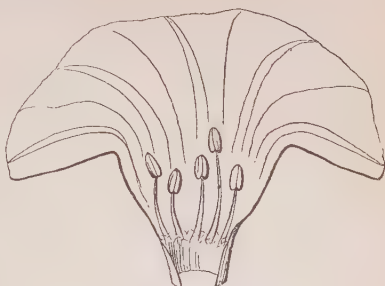
283. In Relation to each

Other, stamens are more commonly

Distinct, that is, without any union with each other. But when united, the following technical terms of long use



284



283



285

indicate their modes of mutual connection:—

Monadelphous (from two Greek words, meaning “in one brotherhood”), when united by their filaments into one set, usually into a ring or cup below, or into a tube, as in the Mallow Family (Fig. 286), the Passion-flower (Fig. 260), the Lupine (Fig. 287), and in Lobelia (Fig. 285).

Diadelphous (meaning in two brotherhoods), when united by the filaments into two sets, as in the Pea and most of its near relatives (Fig. 288), usually nine in one set, and one in the other.

Triadelphous (three brotherhoods), when the filaments are united in three sets or clusters, as in most species of Hypericum.

FIG. 283. Corolla of Morning Glory laid open, to show the five stamens inserted on it, near the base.

FIG. 284. Style of a Lady's Slipper (Cypripedium), and stamens united with it; *a, a*, the anthers of the two good stamens; *st*, an abortive stamen, what should be its anther changed into a petal-like body; *stig*, the stigma.

FIG. 285. Flower of Lobelia cardinalis, Cardinal flower; corolla making approach to the ligulate form; filaments (*st*) monadelphous, and anthers (*a*) syngenesious.

Pentadelphous (five brotherhoods), when in five sets, as in some species of *Hypericum* and in American Linden (Fig. 277, 289).

Polyadelphous (many or several brotherhoods) is the term generally employed when these sets are several, or even more than two, and the particular number is left unspecified. These terms all relate to the filaments.

Syngenesious is the term to denote that stamens have their anthers united, coalescent into a ring or tube; as in *Lobelia* (Fig. 285), in *Violets*, and in all of the great family of *Compositæ*.

284. Their Number in a flower is commonly expressed directly, but sometimes adjectively, by a series of terms which were the name of classes in the Linnæan artificial system, of which the following names, as also the preceding, are a survival:—

Monandrous, i. e. solitary-stamened, when the flower has only one stamen,

Diandrous, when it has two stamens only,

Triandrous, when it has three stamens,

Tetrandrous, when it has four stamens,

Pentandrous, when it has five stamens,

Hexandrous, when with six stamens, and so on to

Polyandrous, when it has many stamens, or more than a dozen.

285. For which terms, see the Glossary. They are all Greek numerals prefixed to *-andria* (from the Greek), which Linnæus used for *androecium*, and are made into an English adjective, *-androus*. Two other terms, of same origin, designate particular cases of number (four or six) in connection with unequal length. Namely, the stamens are

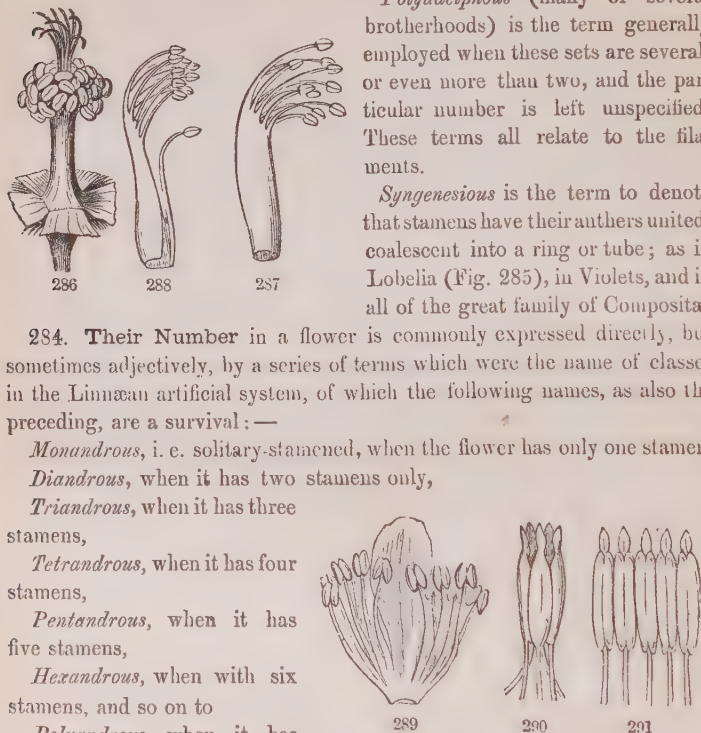
Didynamous, when, being only four, they form two pairs, one pair longer than the other, as in the Trumpet Creeper, in *Gerardia* (Fig. 263), etc.

FIG. 286. Flower of a Mallow, with calyx and corolla cut away; showing monadelphous stamens.

FIG. 287. Monadelphous stamens of Lupine. 288. Diadelphous stamens (9 and 1) of a Pea-blossom.

FIG. 289. One of the five stamen-clusters of the flower of American Linden, with accompanying scale. The five clusters are shown in section in the diagram of this flower, Fig. 277.

FIG. 290. Five syngenesious stamens of a *Coreopsis*. 291. Same, with tube laid open and displayed.



Tetradynamous, when, being only six, four of them surpass the other two, as in the Mustard-flower and all the Cruciferous family, Fig. 235.

286. The **Filament** is a kind of stalk to the anther, commonly slender or thread-like: it is to the anther nearly what the petiole is to the blade of a leaf. Therefore it is not an essential part. As a leaf may be without a stalk, so the anther may be *Sessile*, or without a filament.

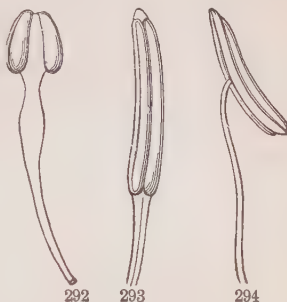
287. The **Anther** is the essential part of the stamen. It is a sort of case, filled with a fine powder, the *Pollen*, which serves to fertilize the pistil, so that it may perfect seeds. The anther is said to be

Innate (as in Fig. 292), when it is attached by its base to the very apex of the filament, turning neither inward nor outward;

Adnate (as in Fig. 293), when attached as it were by one face, usually for its whole length, to the side of a continuation of the filament; and

Versatile (as in Fig. 294), when fixed by or near its middle only to the very point of the filament, so as to swing loosely, as in the Lily, in Grasses, etc. Versatile or adnate anthers are

Introrse, or *Incumbent*, when facing inward, that is, toward the centre of the flower, as in Magnolia, Water-Lily, etc.



Extrorse, when facing outwardly, as in the Tulip-tree.

288. Rarely does a stamen bear any resemblance to a leaf, or even to a petal or flower-leaf. Nevertheless, the botanist's idea of a stamen is that it answers to a leaf developed in a peculiar form and for a special purpose. In the filament he sees the stalk of the leaf; in the anther, the blade. The blade of a leaf consists of two similar sides; so the anther consists of two **LOBES** or **CELLS**, one answering to the left, the other to the right, side of the blade. The two lobes are often connected by a prolongation of the filament, which answers to the midrib of a leaf; this is called the **CONNECTIVE**. This is conspicuous in Fig. 292, where the connective is so broad that it separates the two cells of the anther to some distance.

289. A simple conception of the morphological relation of an anther to a leaf is given in Fig. 295, an ideal figure, the lower part representing a stamen with the top of its anther cut away; the upper, the corresponding upper part of a leaf.



FIG. 292. Stamen of *Isopyrum*, with innate anther. 293. Of Tulip-tree, with adnate (and extrorse) anther. 294. Of Evening Primrose, with versatile anther.

FIG. 295. Diagram of the lower part of an anther, cut across above, and the upper part of a leaf, to show how the one answers to the other; the filament to petiole, the connective to midrib; the two cells to the right and left halves of the blade.

290. So anthers are generally *two-celled*. But as the pollen begins to form in two parts of each cell (the anterior and the posterior), sometimes these two strata are not confluent, and the anther even at maturity may be *four-celled*, as in Moonseed (Fig 296); or rather, in that case (the word *cell* being used for each lateral half of the organ), it is *two-celled*, but the cells *bilocellate*.

291. But anthers may become *one-celled*, and that either by confluence or by suppression.

292. By confluence, when the two cells run together into one, as they nearly do in most species of *Pentstemon* (Fig. 297), more so in *Monarda* (Fig. 300), and completely in the Mallow (Fig. 298) and all the Mallow family.

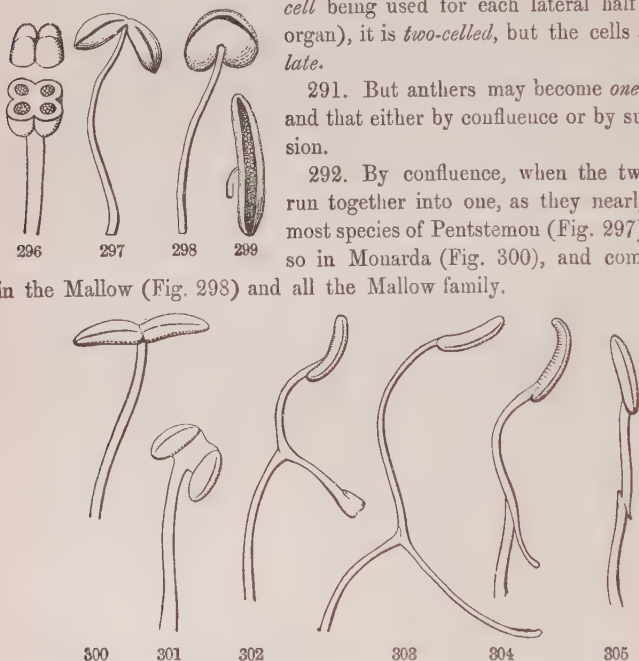


FIG. 296. Stamen of Moonseed, with anther cut across; this 4-celled, or rather 4-locellate.

FIG. 297. Stamen of *Pentstemon pubescens*; the two anther-cells diverging, and almost confluent.

FIG. 298. Stamen of Mallow; the anther supposed to answer to that of Fig. 297, but the cells completely confluent into one.

FIG. 299. Stamen of Globe Amaranth; very short filament bearing a single anther-cell; it is open from top to bottom, showing the pollen within.

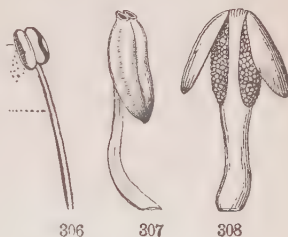
FIG. 300-305. Stamens of several plants of the Labiate or Mint Family. FIG. 300. Of a *Monarda*: the two anther-cells with bases divergent so that they are transverse to the filament, and their contiguous tips confluent, so as to form one cell opening by a continuous line. FIG. 301. Of a *Calamintha*: the broad connective separating the two cells. FIG. 302. Of a Sage (*Salvia Texana*); with long and slender connective resembling forks of the filament, one bearing a good anther-cell; the other an abortive or poor one. FIG. 303. Another Sage (*S. coccinea*), with connective longer and more thread-shaped, the lower fork having its anther-cell wholly wanting. FIG. 304. Of a White Sage, *Audibertia grandiflora*; the lower fork of connective a mere vestige. FIG. 305. Of another White Sage (*A. stachyoides*), the lower fork of connective suppressed.

293. By suppression, in certain cases the anther may be reduced to one cell or halved. In Globe Amaranth (Fig. 299) there is a single cell without vestige of any other. Different species of Sage and of the White Sages of California show various grades of abortion of one of the anther-cells, along with a singular lengthening of the connective (Fig. 302-305).

294. The splitting open of an anther for the discharge of its pollen is termed its *Dehiscence*.

295. As the figures show, this is commonly by a line along the whole length of each cell, either lateral or, when the anthers are extrorse, often along the outer face, and when introrse, along the inner face of each cell. Sometimes the opening is only by a chink, hole, or pore at the top, as in the Azalea, Pyrola (Fig. 307), etc.; sometimes a part of the face separates as a sort of trap-door (or valve), hinged at the top, and opening to allow the escape of the pollen, as in the Sassafras, Spice-bush, and Barberry (Fig. 308).

296. Pollen. This is the powdery matter, commonly of a yellow color, which fills the cells of the anther, and is discharged during blossoming,



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after which the stamens generally fall or wither away. Under the microscope it is found to consist of grains, usually round or oval, and all alike in the same species, but very different in different plants. So that the



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plant may sometimes be recognized from the pollen alone. Several forms are shown in the accompanying figures.

FIG. 306. Stamen with the usual dehiscence of anther down, the side of each cell.

FIG. 307. Stamen of *Pyrola*; cells opening by a terminal hole.

FIG. 308. Stamen of *Barberry*; cells of anther each opening by an uplifted valve.

FIG. 309. Magnified pollen of a *Lily*, smooth and oval; 310, of *Echinocystis*, grooved lengthwise; 311, of *Sicyos*, with bristly points and smooth bands; 312, of *Musk Plant* (*Mimulus*), with spiral grooves; 313, of *Succory*, twelve-sided and dotted.

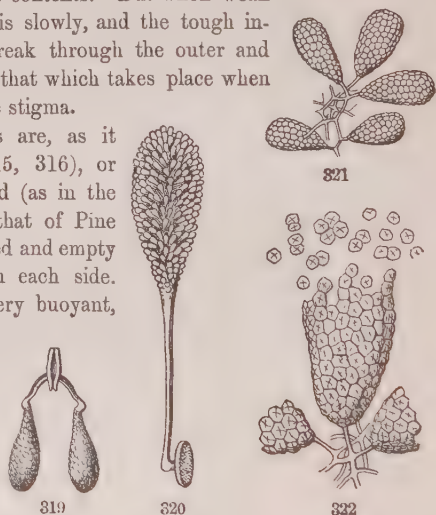
FIG. 314. Magnified pollen of *Hibiscus* and other *Mallow-plants*, beset with prickly projections; 315, of *Cereæ*, with angles bearing little lobes; 316, of *Even*.

297. An ordinary pollen-grain has two coats; the outer coat thickish, but weak, and frequently adorned with lines or bands, or studded with points; the inner coat is extremely thin and delicate, but extensible, and its cavity when fresh contains a thickish protoplasmic fluid, often rendered turbid by an immense number of minute particles that float in it. As the pollen matures this fluid usually dries up, but the protoplasm does not lose its vitality. When the grain is wetted it absorbs water, swells up, and is apt to burst, discharging the contents. But when weak syrup is used it absorbs this slowly, and the tough inner coat will sometimes break through the outer and begin a kind of growth, like that which takes place when the pollen is placed upon the stigma.

298. Some pollen-grains are, as it were, lobed (as in Fig. 315, 316), or formed of four grains united (as in the Heath family, Fig. 317): that of Pine (Fig. 318) has a large rounded and empty bladder-like expansion upon each side. This renders such pollen very buoyant, and capable of being transported to a great distance by the wind.

299. In species of *Acacia* simple grains lightly cohere into globular pellets. In Milkweeds and in most Orchids all the pollen of an

anther-cell is compacted or coherent into one mass, called a *Pollen-mass*, or *POLLINIUM*, plural *POLLINIA*. (Fig. 319-322.)



ing Primrose, the three lobes as large as the central body; 317, of *Kalmia*, four grains united, as in most of the Heath family; 318, of Pine, as it were of three grains or cells united; the lateral empty and light.

FIG. 319. Pollen, a pair of pollinia of a Milkweed, *Asclepias*, attached by stalks to a gland; moderately magnified.

FIG. 320. Pollinium of an Orchis (*Habenaria*), with its stalk attached to a sticky gland; magnified. 321. Some of the packets or partial pollinia, of which Fig. 320 is made up, more magnified.

FIG. 322. One of the partial pollinia, torn up at top to show the grains (which are each composed of four), and highly magnified.

SECTION X. PISTILS IN PARTICULAR.

§ 1. ANGIOSPERMOUS OR ORDINARY GYNÆCIUM.

300. **Gynæcium** is the technical name for the pistil or pistils of a flower taken collectively, or for whatever stands in place of these. The various modifications of the gynæcium and the terms which relate to them require particular attention.

301. **THE PISTIL**, when only one, occupies the centre of the flower; when there are two pistils, they stand facing each other in the centre of the flower; when several, they commonly form a ring or circle; and when very numerous, they are generally crowded in rows or spirals on the surface of a more or less enlarged or elongated receptacle. Their number gives rise to certain terms, the counterpart of those used for stamens (284), which are survivals of the names of orders in the Linnæan artificial system. The names were coined by prefixing Greek numerals to *-gynia* used for gynæcium, and changed into adjectives in the form of *-gynous*. That is, a flower is

Monogynous, when it has a single pistil, whether that be simple or compound;

Digynous, when it has only two pistils; *Trigynous*, when with three; *Tetragynous*, with four; *Pentagynous*, with five; *Hexagynous*, with six; and so on to *Polygynous*, with many pistils.

302. **The Parts of a Complete Pistil**, as already twice explained (16, 236), are the **OVARY**, the **STYLE**, and the **STIGMA**. The ovary is one essential part: it contains the rudiments of seeds, called **OVULES**. The stigma at the summit is also essential: it receives the pollen, which fertilizes the ovules in order that they may become seeds. But the style, commonly a tapering or slender column borne on the summit of the ovary, and bearing the stigma on its apex or its side, is no more necessary to a pistil than the filament is to the stamen. Accordingly, there is no style in many pistils: in these the stigma is *sessile*, that is, rests directly on the ovary (as in Fig. 326). The stigma is very various in shape and appearance, being sometimes a little knob (as in the Cherry, Fig. 271), sometimes a point or small surface of bare tissue (as in Fig. 327-330), and sometimes a longitudinal crest or line (as in Fig. 324, 341-343), or it may occupy the whole length of the style, as in Fig. 331.

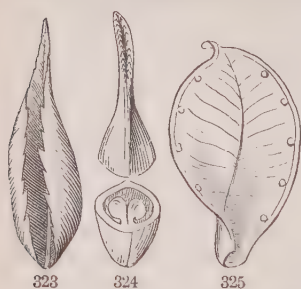
303. The word **Pistil** (Latin, *Pistillum*) means a pestle. It came into use in the first place for such flowers as those of Crown Imperial, or Lily, in which the pistil in the centre was likened to the pestle, and the perianth around it to the mortar, of the apothecary.

304. A pistil is either *simple* or *compound*. It is simple when it answers to a single flower-leaf, compound when it answers to two or three, or a fuller circle of such leaves conjoined.

305. **Carpels.** It is convenient to have a name for each flower-leaf of the gynoecium; so it is called a *Carpel*, in Latin *Carpellum* or *Carpidium*. A simple pistil is a carpel. Each component flower-leaf of a compound pistil is likewise a carpel. When a flower has two or more pistils, these of course are simple pistils, that is, separate carpels or pistil-leaves. There may be only a single simple pistil to the flower, as in a Pea or Cherry blossom (Fig. 271); there may be two such, as in many Saxifrages; or many, as in the Strawberry. More commonly the single pistil in the centre of a blossom is a compound one. Then there is seldom much difficulty in ascertaining the number of carpels or pistil-leaves that compose it.

306. **The Simple Pistil**, viewed morphologically, answers to a leaf-blade with margins incurved and united where they meet, so forming a closed case or pod (the ovary), and bearing ovules at the suture or junction of these margins: a tapering upper portion with margins similarly inrolled, is supposed to form the style; and these same margins, exposed at the tip or for a portion of the length, become the stigma. Compare, under this view, the three accompanying figures.

307. So a simple pistil should have a one-celled ovary, only one line of



attachment for the ovules, a single style, and a single stigma. Certain variations from this normal condition which sometimes occur do not invalidate this morphological conception. For instance, the stigma may become two-lobed or two-ridged, because it consists of two leaf-margins, as Fig. 324 shows; it may become 2-locellate by the turning or growing inward of one of the sutures, so as to divide the cavity.

308. There are two or three terms which primarily relate to the parts of a simple pistil or carpel, and are thence carried on to the compound pistil, viz.:—

VENTRAL SUTURE, the line which answers to the united margins of the carpel-leaf, therefore naturally called a suture or seam, and the ventral or inner one, because in the circle of carpel-leaves it looks inward or to the centre of the flower.

DORSAL SUTURE is the line down the back of the carpel, answering to

FIG. 323. An inrolled small leaf, such as in double-flowered Cherry blossoms is often seen to occupy the place of a pistil.

FIG. 324. A simple pistil (of *Isopyrum*), with ovary cut across; the inner (ventral) face turned toward the eye: the ovules seem to be borne on the ventral suture, answering to leaf-margins: the stigma above seen also to answer to leaf-margins.

FIG. 325. Pod or simple pistil of *Caltha* or Marsh-Marigold, which has opened, and shed its seeds.

the midrib of the leaf,—not a seam therefore; but at maturity many fruits, such as pea-pods, open by this dorsal as well as by the ventral line.

PLACENTA, a name given to the surface, whatever it be, which bears the ovules and seeds. The name may be needless when the ovules grow directly on the ventral suture, or from its top or bottom; but when there are many ovules there is usually some expansion of an ovule-bearing or seed-bearing surface; as is seen in our Mandrake or Podophyllum, Fig. 326.

309. A **Compound Pistil** is a combination of two, three, or a greater number of pistil-leaves or carpels in a circle, united into one body, at least



by their ovaries. The annexed figures should make it clear. A series of Saxifrages might be selected the gynœcium of which would show every gradation between two simple pistils, or separate carpels, and their complete coalescence into one compound and two-celled ovary. Even when the constituent styles and stigmas are completely coalescent into one, the nature of the combination is usually revealed by some external lines or grooves, or (as in Fig. 328–330) by the internal partitions, or the number of the placentæ. The simplest case of compound pistil is that

310. With **two or more Cells and Axile Placentæ**, namely, with as many cells as there are carpels, that have united to compose the organ.

FIG. 326. Simple pistil of Podophyllum, cut across, showing ovules borne on placenta.

FIG. 327. Pistil of a Saxifrage, of two simple carpels or pistil-leaves, united at the base only, cut across both above and below.

FIG. 328. Compound 3-carpellary pistil of common St. John's-wort, cut across: the three styles separate.

FIG. 329. The same of shrubby St. John's-wort; the three styles as well as ovaries here united into one.

FIG. 330. Compound 3-carpellary pistil of Tradescantia or Spiderwort; the three stigmas as well as styles and ovary completely coalescent into one.

Such a pistil is just what would be formed if the simple pistils (two, three, or five in a circle, as the case may be), like those of a *Pæony* or *Stonecrop* (Fig. 224, 225), pressed together in the centre of the flower, were to cohere by their contiguous parts. In such a case the placenta are naturally *axile*, or all brought together in the axis or centre; and the ovary has as many *Dissepiments*, or internal *Partitions*, as there are carpels in its composition. For these are the contiguous and coalescent walls or sides of the component carpels. When such pistils ripen into pods, they often separate along these lines into their elementary carpels.

311. **One-celled, with free Central Placenta.** The commoner case is that of *Purslane* (Fig. 272) and of the *Pink* and *Chickweed* families (Fig. 331, 332). This is explained by supposing that the partitions (such as those of Fig. 329) have early vanished or have been suppressed. Indeed, traces of them may often be detected in *Pinks*. On the other hand, it is equally supposable that in the *Primula* family the free central is derived from parietal placentation by the carpels bearing ovules only at base, and forming a consolidated common placenta in the axis. *Mitella* and *Dionæa* help out this conception.

312. **One-celled, with Parietal Placentæ.** In this not uncommon case it is conceived that the two or three or more carpel-leaves of such a compound pistil coalesce by their adjacent edges, just as sepal-leaves do to form a gamosepalous calyx,

or petals to form a gamopetalous corolla, and as is shown in the diagram, Fig. 333, and in an actual cross-section



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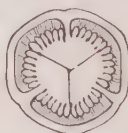
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tion, Fig. 334. Here each carpel is an open leaf, or with some introflexion, bearing ovules along its margins; and each placenta consists of the con-

FIG. 331, 332. Pistil of a Sandwort, with vertical and transverse section of the ovary: free central placenta.

FIG. 333. Plan of a one-celled ovary of three carpel-leaves, with parietal placentæ, cut across below, where it is complete; the upper part showing the top of the three leaves it is composed of, approaching, but not united.

FIG. 334. Cross section of the ovary of Frost-weed (*Helianthemum*), with three parietal placentæ, bearing ovules.

FIG. 335. Cross section of an ovary of *Hypericum graveolens*, the three large placentæ meeting in the centre, so as to form a three-celled ovary. 336. Same in fruit, the placentæ now separate and rounded.

liguous margins of two pistil-leaves grown together. There is every gradation between this and the three-celled ovary with the placentæ in the axis, even in the same genus, sometimes even in different stages in the same pistil (Fig. 335, 336).

§ 2. GYMNOSPERMOUS GYNÆCIUM.

313. The ordinary pistil has a closed ovary, and accordingly the pollen can act upon the contained ovules only indirectly, through the stigma. This is expressed in a term of Greek derivation, viz.: —

Angiospermous, meaning that the seeds are borne in a sac or closed vessel. The counterpart term is

Gymnospermous, meaning naked-seeded. This kind of pistil, or gynæcium, the simplest of all, yet the most peculiar, characterizes the Pine family and its relatives.

314. While the ordinary simple pistil is conceived by the botanist to be a leaf rolled together into a closed pod (306), those of the Pine, Larch (Fig. 337), Cedar, and Arbor-Vitæ (Fig. 338, 339) are open leaves, in the form of scales, each bearing two or more ovules on the inner face, next the base. At the time of blossoming, these pistil-leaves of the young cone diverge,



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and the pollen, so abundantly shed from the staminate blossoms, falls directly upon the exposed ovules. Afterward the scales close over each other until the seeds are ripe. Then they separate that the seeds may be shed. As the pollen acts directly on the ovules, such pistil (or organ acting as pistil) has no stigma.

315. In the Yew, and in *Torreya* and *Ginkgo*, the gynæcium is reduced to extremest simplicity, that is, to a naked ovule, without any visible carpel.

316. In *Cycas* the large naked ovules are borne on the margins or lobes of an obvious open leaf. All GYMNOSPERMOUS plants have other peculiarities, also distinguishing them, as a class, from ANGIOSPERMOUS plants.



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FIG. 337. A pistil, that is, a scale of the cone, of a Larch, at the time of flowering; inside view, showing its pair of naked ovules.

FIG. 338. Branchlet of the American Arbor-Vitæ, considerably larger than in nature, terminated by its pistillate flowers, each consisting of a single scale (an open pistil), together forming a small cone.

FIG. 339. One of the scales or carpels of the last, removed and more enlarged, the inside exposed to view, showing a pair of ovules on its base.

SECTION XI. OVULES.

317. **Ovule** (from the Latin, meaning a little egg) is the technical name of that which in the flower answers to and becomes the seed.

318. Ovules are *naked* in gymnospermous plants (as just described); in all others they are enclosed in the ovary. They may be produced along the



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whole length of the cell or cells of the ovary, and then they are apt to be numerous; or only from some part of it, generally the top or the bottom. In this case they are usually few or single (*solitary*, as in Fig. 341-343). They may be *sessile*, i. e. without stalk, or they may be attached by a distinct stalk, the **FUNICLE** or **FUNICULUS** (Fig. 340).

319. Considered as to their position and direction in the ovary, they are *Horizontal*, when they are neither turned upward nor downward, as in *Podophyllum* (Fig. 326);

Ascending, when rising obliquely upwards, usually from the side of the cell, not from its very base, as in the *Buttercup* (Fig. 341), and the *Purslane* (Fig. 272);

Erect, when rising upright from the very base of the cell, as in the *Buckwheat* (Fig. 342);

Pendulous, when hanging from the side or from near the top, as in the *Flax* (Fig. 270); and

Suspended, when hanging perpendicularly from the very summit of the cell, as in the *Anemone* (Fig. 343). All these terms equally apply to seeds.



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320. In structure an ovule is a pulpy mass of tissue, usually with one or two coats or coverings. The following parts are to be noted; viz:—

KERNEL or **NUCLEUS**, the body of the ovule. In the *Mistletoe* and some related plants, there is only this nucleus, the coats being wanting.

TÉGUMENTS, or coats, sometimes only one, more commonly two. When two, one has been called **PRIMINE**, the other **SECUNDINE**. It will serve all purposes to call them simply outer and inner ovule-coats.

ORIFICE, or **FORAMEN**, an opening through the coats at the organic apex of the ovule. In the seed it is *Micropyle*.

CHALAZA, the place where the coats and the kernel of the ovule blend.

HILUM, the place of junction of the funiculus with the body of the ovule.

FIG. 340. A cluster of ovules, pendulous on their funicles.

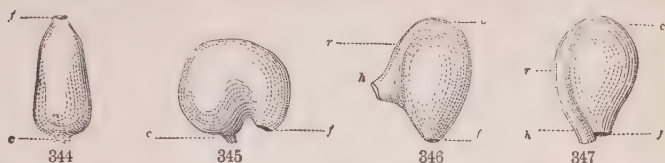
FIG. 341. Section of the ovary of a *Buttercup*, lengthwise, showing its ascending ovule.

FIG. 342. Section of the ovary of *Buckwheat*, showing the erect ovule.

FIG. 343. Section of the ovary of *Anemone*, showing its suspended ovule.

321 The Kinds of Ovules. The ovules in their growth develop in three or four different ways, and thereby are distinguished into

Orthotropous or *Straight*, those which develop without curving or turn-



ing, as in Fig. 344. The chalaza is at the insertion or base; the foramen or orifice is at the apex. This is the simplest, but the least common kind of ovule.

Campylotropous or *Incurved*, in which, by the greater growth of one side,



the ovule curves into a kidney-shaped outline, so bringing the orifice down close to the base or chalaza; as in Fig. 345.

Amphitropous or *Half-Inverted*, Fig. 346. Here the forming ovule, instead of curving perceptibly, keeps its axis nearly straight, and, as it grows, turns round upon its base so far as to become transverse to its funiculus, and adnate to its upper part for some distance. Therefore in this case the attachment of the funiculus or stalk is about the middle, the chalaza is at one end, the orifice at the other.

Anatropous or *Inverted*, as in Fig. 347, the commonest kind, so called because in its growth it has as it were turned over upon its stalk, to which it has continued adnate. The organic base, or chalaza, thus becomes the apparent summit, and the

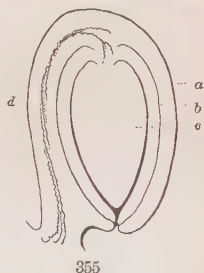


FIG. 344. Orthotropous ovule of Buckwheat; c, hilum and chalaza; f, orifice.

FIG. 345. Campylotropous ovule of a Chickweed: c, hilum and chalaza; f, orifice.

FIG. 346. Amphitropous ovule of Mallow: f, orifice; h, hilum; r, rhaphe; c, chalaza.

FIG. 347. Anatropous ovule of a Violet; the parts lettered as in the last.

FIG. 348-350. Three early stages in the growth of ovule of a Magnolia, showing the forming outer and inner coats, which, even in the later figure have not yet completely enclosed the nucleus; 351, further advanced, and 352, completely anatropous ovule.

FIG. 353. Longitudinal section, and 354, transverse section of 352.

FIG. 355. Same as 353, enlarged, showing the parts in section: a, outer coat; b, inner coat; c, nucleus; d, rhaphe.

orifice is at the base, by the side of the hilum or place of attachment. The aduate portion of the funiculus, which appears as a ridge or cord extending from the hilum to the chalaza, and which distinguishes this kind of ovule, is called the RHAPHE. The amphitropous ovule (Fig. 346) has a short or incomplete rhaphe.

322. Fig. 348-352 show the stages through which an ovule becomes anatropous in the course of its growth. The annexed two figures are sections of such an ovule at maturity; and Fig. 355 is Fig. 353 enlarged, with the parts lettered.

SECTION XII. MODIFICATIONS OF THE RECEPTACLE.

323. The **Torus** or Receptacle of the flower (237, Fig. 223) is the portion which belongs to the stem or axis. In all preceding illustrations it is small and short. But it sometimes lengthens, sometimes thickens or variously enlarges, and takes on various forms. Some of these have received special names, very few of which are in common use. A lengthened portion of the receptacle is called

A **STIPE**. This name, which means simply a trunk or stalk, is used in



botany for various stalks, even for the leaf-stalk in Ferns. It is also applied to the stalk or petiole of a carpel, in the rare cases when there is any, as in

FIG. 356. Longitudinal section of flower of *Silene pennsylvanica*, showing stipe between calyx and corolla.

FIG. 357. Flower of a *Cleome* of the section *Gynandropsis*, showing broadened receptacle to bear petals, lengthened stipe below the stamens, and another between these and pistil.

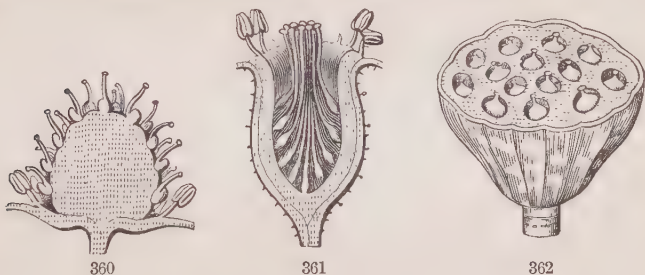
FIG. 358. Pistil of *Geranium* or *Cranesbill*.

FIG. 359. The same, ripe, with the five carpels splitting away from the long beak (carphophore), and hanging from its top by their recurving styles.

Goldthread. Then it is technically distinguished as a **THECAPHORE**. When there is a stalk, or lengthened internode of receptacle, directly under a compound pistil, as in *Stanleya* and some other *Cruciferae*, it is called a **GYNOPHORE**. When the stalk is developed below the stamens, as in most species of *Silene* (Fig. 356), it has been called an **ANTHOPHORE** or **GONOPHORE**. In Fig. 357 the torus is dilated above the calyx where it bears the petals, then there is a long internode (gonophore) between it and the stamens; then a shorter one (gynophore) between these and the pistil.

324. A **Carpophore** is a prolongation of receptacle or axis between the carpels and bearing them. Umbelliferous plants and *Geranium* (Fig. 358, 359) afford characteristic examples.

325. Flowers with very numerous simple pistils generally have the receptacle enlarged so as to give them room; sometimes becoming broad and flat, as in the Flowering Raspberry, sometimes elongated, as in the Black-



berry, the *Magnolia*, etc. It is the receptacle in the Strawberry (Fig. 360), much enlarged and pulpy when ripe, which forms the eatable part of the fruit, and bears the small seed-like pistils on its surface. In the Rose (Fig. 361), instead of being convex or conical, the receptacle is deeply concave, or urn-shaped. Indeed, a Rose-hip may be likened to a strawberry turned inside out, like the finger of a glove reversed, and the whole covered by the adherent tube of the calyx. The calyx remains beneath in the strawberry.

326. In *Nelumbium*, of the Water-Lily family, the singular and greatly enlarged receptacle is shaped like a top, and bears the small pistils immersed in separate cavities of its flat upper surface (Fig. 362).

327. A **Disk** is an enlarged low receptacle or an outgrowth from it, *hypogynous* when underneath the pistil, as in Rue and the Orange (Fig. 363), and *perigynous* when adnate to calyx-tube (as in Buckthorn, Fig. 364, 365), and Cherry (Fig. 271), or



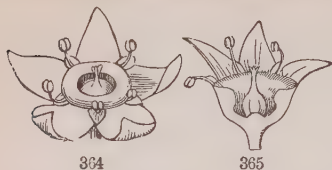
FIG. 360. Longitudinal section of a young strawberry, enlarged.

FIG. 361. Similar section of a young Rose-hip.

FIG. 362. Enlarged and top-shaped receptacle of *Nelumbium*, at maturity.

FIG. 363. Hypogynous disk in Orange.

to both calyx-tube and ovary, as in Hawthorn (Fig. 273). A flattened hypogynous disk, underlying the ovary or ovaries, and from which they fall away at maturity, is sometimes called a GYNOBASE, as in the Rue family. In some Borragineous flowers, such as Houndstongue, the gynobase runs up in the centre between the carpels into a carpophore. The so-called *epigynous* disk (or STYLOPODIUM) crowning the summit of the ovary in flowers of Umbelliferæ, etc., cannot be said to belong to the receptacle.



SECTION XIII. FERTILIZATION.

328. The end of the flower is attained when the ovules become seeds. A flower remains for a certain time (longer or shorter according to the species) in *anthesis*, that is, in the proper state for the fulfilment of this end. During anthesis, the ovules have to be fertilized by the pollen; or at least some pollen has to reach the stigma, or in gymnospermy the ovule itself, and to set up the peculiar growth upon its moist and permeable tissue, which has for result the production of an embryo in the ovules. By this the ovules are said to be *fertilized*. The first step is *pollination*, or, so to say, the sowing of the proper pollen upon the stigma, where it is to germinate.

§ 1. ADAPTATIONS FOR POLLINATION OF THE STIGMA.

329. These various and ever-interesting adaptations and processes are illustrated in the "Botanical Text Book, Structural Botany," chap. VI. sect. iv., also in a brief and simple way in "Botany for Young People, How Plants Behave." So mere outlines only are given here.

330. Sometimes the application of pollen to the stigma is left to chance, as in dioecious wind-fertilized flowers; sometimes it is rendered very sure, as in flowers that are fertilized in the bud; sometimes the pollen is prevented from reaching the stigma of the same flower, although placed very near to it, but then there are always arrangements for its transference to the stigma of some other blossom of the kind. It is among these last that the most exquisite adaptations are met with.

331. Accordingly, some flowers are particularly adapted to close or self-fertilization; others to cross fertilization; some for either, according to circumstances.

FIG. 364. Flower of a Buckthorn showing a conspicuous perigynous disk.

FIG. 365. Vertical section of same flower.

Close Fertilization occurs when the pollen reaches and acts upon a stigma of the very same flower (this is also called self-fertilization), or, less closely, upon other blossoms of the same cluster or the same individual plant.

Cross Fertilization occurs when ovules are fertilized by pollen of other individuals of the same species.

Hybridization occurs when ovules are fertilized by pollen of some other (necessarily some nearly related) species.

332. **Close Fertilization** would seem to be the natural result in ordinary hermaphrodite flowers; but it is by no means so in all of them. More commonly the arrangements are such that it takes place only after some opportunity for cross fertilization has been afforded. But close fertilization is inevitable in what are called

Cleistogamous Flowers, that is, in those which are fertilized in the flower-bud, while still unopened. Most flowers of this kind, indeed, never open at all; but the closed floral coverings are forced off by the growth of the precociously fertilized pistil. Common examples of this are found in the earlier blossoms of *Specularia perfoliata*, in the later ones of most Violets, especially the stemless species, in our wild Jewel weeds or *Impatiens*, in the subterranean shoots of *Amphicarpæa*. Every plant which produces these cleistogamous or bud-fertilized flowers bears also more conspicuous and open flowers, usually of bright colors. The latter very commonly fail to set seed, but the former are prolific.

333. **Cross Fertilization** is naturally provided for in diœcious plants (249), is much favored in monœcious plants (249), and hardly less so in dichogamous and in heterogonous flowers (338). Cross fertilization depends upon the transportation of pollen; and the two principal agents of conveyance are winds and insects. Most flowers are in their whole structure adapted either to the one or to the other.

334. **Wind-fertilizable or Anemophilous** flowers are more commonly diœcious or monœcious, as in Pines and all coniferous trees, Oaks, and Birches, and Sedges; yet sometimes hermaphrodite, as in Plantains and most Grasses; they produce a superabundance of very light pollen, adapted to be wind-borne; and they offer neither nectar to feed winged insects, nor fragrance nor bright colors to attract them.

335. **Insect-fertilizable or Entomophilous** flowers are those which are sought by insects, for pollen or for nectar, or for both. Through their visits pollen is conveyed from one flower and from one plant to another. Insects are attracted to such blossoms by their bright colors, or their fragrance, or by the nectar (the material of honey) there provided for them. While supplying their own needs, they carry pollen from anthers to stigmas and from plant to plant, thus bringing about a certain amount of cross fertilization. Willows and some other diœcious flowers are so fertilized, chiefly by bees. But most insect-visited flowers have the stamens and pistils associated either in the same or in contiguous blossoms. Even when in the same blossom, anthers and stigmas are very commonly so situated

that under insect-visitation, some pollen is more likely to be deposited upon other than upon own stigmas, so giving a chance for cross as well as for close fertilization. On the other hand, numerous flowers, of very various kinds, have their parts so arranged that they must almost necessarily be cross-fertilized or be barren, and are therefore dependent upon the aid of insects. This aid is secured by different exquisite adaptations and contrivances, which would need a volume for full illustration. Indeed, there is a good number of volumes devoted to this subject.¹

336. Some of the adaptations which favor or ensure cross fertilization are peculiar to the particular kind of blossom. Orchids, Milkweeds, *Kalmia*, *Iris*, and papilionaceous flowers each have their own special contrivances, quite different for each.

337. Irregular flowers (253) and especially irregular corollas are usually adaptations to insect-visitation. So are all *Nectaries*, whether hollow spurs, sacs, or other concavities in which nectar is secreted, and all *nectariferous glands*.

338. Moreover, there are two arrangements for cross fertilization common to hermaphrodite flowers in various different families of plants, which have received special names, *Dichogamy* and *Heterogony*.

339. *Dichogamy* is the commoner case. Flowers are *dichogamous* when the anthers discharge their pollen either before or after the stigmas of that flower are in a condition to receive it. Such flowers are

Proterandrous, when the anthers are earlier than the stigmas, as in *Gentians*, *Campanula*, *Epilobium*, etc.

Proterogynous, when the stigmas are mature and moistened for the reception of pollen, before the anthers of that blossom are ready to supply it, and are withered before that pollen can be supplied. Plantains or Ribworts (mostly wind-fertilized) are strikingly proterogynous: so is *Amorpha*, our Papaws, *Scrophularia*, and in a less degree the blossom of Pears, Hawthorns, and Horse-chestnut.

340. In *Sabbatia*, the large-flowered species of *Epilobium*, and strikingly in *Clerodendron*, the dichogamy is supplemented and perfected by movements of the stamens and style, one or both, adjusted to make sure of cross fertilization.

341. *Heterogony*. This is the case in which hermaphrodite and fertile flowers of two sorts are produced on different individuals of the same species; one sort having higher anthers and lower stigmas, the other having higher stigmas and lower anthers. Thus reciprocally disposed, a visiting insect carries pollen from the high anthers of the one to the high stigma of the other, and from the low anthers of the one to the low stigma of the other. These plants are practically as if diœcious, with the advantage that

¹ Beginning with one by C. C. Sprengel in 1793, and again in our day with Darwin, "On the Various Contrivances by which Orchids are fertilized by Insects," and in succeeding works.

both kinds are fruitful. *Houstonia* and *Mitchella*, or Partridge-berry, are excellent and familiar examples. These are cases of

Heterogone Dimorphism, the relative lengths being only short and long reciprocally.

Heterogone Trimorphism, in which there is a mid-length as well as a long and a short set of stamens and style; occurs in *Lythrum Salicaria* and some species of *Oxalis*.

342. There must be some essential advantage in cross fertilization or cross breeding. Otherwise all these various, elaborate, and exquisitely adjusted adaptations would be aimless. Doubtless the advantage is the same as that which is realized in all the higher animals by the distinction of sexes.

§ 2. ACTION OF POLLEN, AND FORMATION OF THE EMBRYO.

343. *Pollen-growth*. A grain of pollen may be justly likened to one of the simple bodies (*spores*) which answer for seeds in Cryptogamous plants. Like one of these, it is capable of germination. When deposited upon the moist surface of the stigma (or in some cases even when at a certain distance) it grows from some point, its living inner coat breaking through the inert outer coat, and protruding in the form of a delicate tube. This as it lengthens penetrates the loose tissue of the stigma and of a loose conducting tissue in the style, feeds upon the nourishing liquid matter there provided, reaches the cavity of the ovary, enters the orifice of an ovule, and attaches its extremity to a sac, or the lining of a definite cavity, in the ovule, called the *Embryo-Sac*.

344. *Origination of the Embryo*. A globule of living matter in the embryo-sac is formed, and is in some way placed in close proximity to the apex of the pollen tube; it probably absorbs the contents of the latter; it then sets up a special growth, and the *Embryo* (8-10) or rudimentary plantlet in the seed is the result.

SECTION XIV. THE FRUIT.

345. *Its Nature*. The ovary matures into the Fruit. In the strictest sense the fruit is the seed-vessel, technically named the PERICARP. But practically it may include other parts organically connected with the pericarp. Especially the calyx, or a part of it, is often incorporated with the ovary, so as to be undistinguishably a portion of the pericarp, and it even forms along with the receptacle the whole bulk of such edible fruits as apples and pears. The receptacle is an obvious part in blackberries, and is the whole edible portion in the strawberry.

346. Also a cluster of distinct carpels may, in ripening, be consolidated or compacted, so as practically to be taken for one fruit. Such are raspber-

ries, blackberries, the Magnolia fruit, etc. Moreover, the ripened product of many flowers may be compacted or grown together so as to form a single compound fruit.

347. Its kinds have therefore to be distinguished. Also various names of common use in descriptive botany have to be mentioned and defined.

348. In respect to composition, accordingly, fruits may be classified into

Simple, those which result from the ripening of a single pistil, and consist only of the matured ovary, either by itself, as in a cherry, or with calyx-tube completely incorporated with it, as in a gooseberry or cranberry.

Aggregate, when a cluster of carpels of the same flower are crowded into a mass; as in raspberries and blackberries.

Accessory or *Anthocarpous*, when the surroundings or supports of the pistil make up a part of the mass; as does the loose calyx changed into a fleshy and berry-like envelope of our Wintergreen (*Gaultheria*, Fig. 366, 367) and Buffalo-berry, which are otherwise simple fruits. In an aggregate fruit such as the strawberry the great mass is receptacle (Fig.

360, 368); and in the blackberry (Fig. 369) the juicy receptacle forms the central part of the savory mass.

Multiple or *Collective*, when formed from several flowers consolidated into one mass, of which the common receptacle or axis of inflorescence, the floral envelopes, and even the bracts, etc., make a part. A mulberry (Fig. 408, which superficially much resembles a blackberry) is of this multiple sort. A pineapple is another example.

349. In respect to texture or consistence, fruits may be

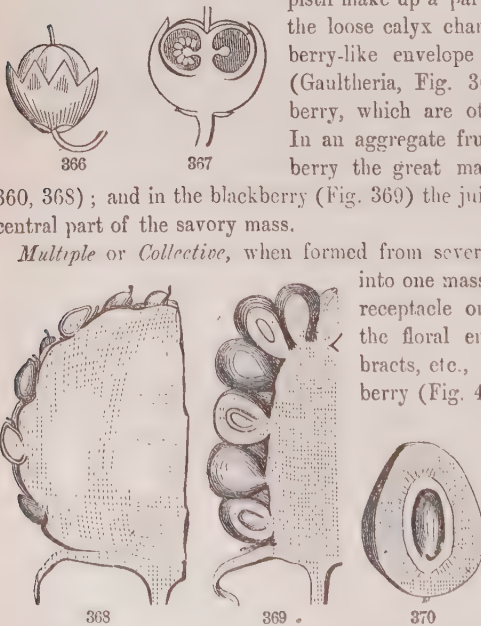
distinguished into three kinds, viz.:—

Fleshy Fruits, those which are more or less soft and juicy throughout;

FIG. 366. Forming fruit (capsule) of *Gaultheria*, with calyx thickening around its base. 367. Section of same mature, the berry-like calyx nearly enclosing the capsule.

FIG. 368. Section of a part of a strawberry. Compare with Fig. 360.

FIG. 369. Similar section of part of a blackberry. 370. One of its component simple fruits (drupe) in section, showing the pulp, stone, and contained seed. more enlarged. Compare with Fig. 375.



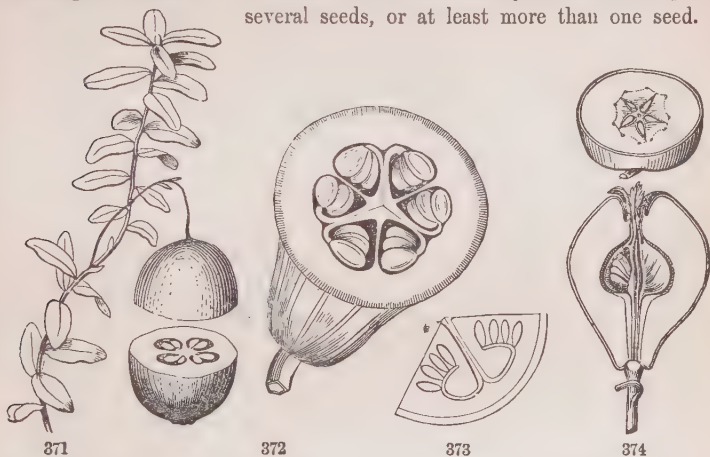
Stone Fruits, or *Drupaceous*, the outer part fleshy like a berry, the inner hard or stony, like a nut; and

Dry Fruits, those which have no flesh or pulp.

350. In reference to the way of disseminating the contained seed, fruits are said to be

Indehiscent when they do not open at maturity. Fleshy fruits and stone fruits are of course indehiscent. The seed becomes free only through decay or by being fed upon by animals. Those which escape digestion are thus disseminated by the latter. Of dry fruits many are indehiscent; and these are variously arranged to be transported by animals. Some burst irregularly; many are

Dehiscent, that is, they split open regularly along certain lines, and discharge the seeds. A dehiscent fruit almost always contains many or several seeds, or at least more than one seed.



351. The principal kinds of fruit which have received substantive names and are of common use in descriptive botany are the following. Of fleshy fruits the leading kind is

352. **The Berry**, such as the gooseberry and currant, the blueberry and cranberry (Fig. 371), the tomato, and the grape. Here the whole flesh is soft throughout. The orange is a berry with a leathery rind.

353. **The Pepo**, or *Gourd-fruit*, is a hard-rinded berry, belonging to the Gourd family, such as the pumpkin, squash, cucumber, and melon, Fig. 372, 373.

354. **The Pome** is a name applied to the apple, pear (Fig. 374), and quince; fleshy fruits, like a berry, but the principal thickness is calyx, only

FIG. 371. Leafy shoot and berry (cut across) of the larger Cranberry, *Vaccinium macrocarpon*

FIG. 372. Pepo of Gourd, in section. 373. One carpel of same in diagram.

FIG. 374. Longitudinal and transverse sections of a pear (pome).

the papery pods arranged like a star in the core really belonging to the carpels. The fruit of the Hawthorn is a drupaceous pome, something between pome and drupe.

355. Of fruits which are externally fleshy and internally hard the leading kind is

356. **The Drupe**, or *Stone-fruit*; of which the cherry, plum, and peach (Fig. 375) are familiar examples. In this the outer part of the thickness of the pericarp becomes fleshy, or softens like a berry, while the inner hardens, like a nut. From the way in which the pistil is constructed, it is evident that the fleshy part here answers to the lower, and the stone to the upper face of the component leaf. The layers or concentric portions of a drupe, or of any pericarp which is thus separable, are named, when thus distinguishable into three portions, —

Epicarp, the external layer, often the mere skin of the fruit,

Mesocarp, the middle layer, which is commonly the fleshy part, and

Endocarp, the innermost layer, the stone. But more commonly only two portions of a drupe are distinguished, and are named, the outer one

Sarcocarp or *Exocarp*, for the flesh, the first name referring to the fleshy character, the second to its being an external layer; and

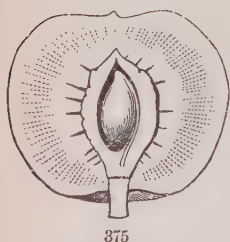
Putamen or *Endocarp*, the *Stone*, within.

357. The typical or true drupe is of a single carpel. But, not to multiply technical names, this name is extended to all such fruits when fleshy without and stony within, although of compound pistil, — even to those having several or separable stones, such as the fruit of Holly. These stones in such drupes, or drupaceous fruits, are called *Pyrenæ*, or *Nucules*, or simply *Nutlets* of the drupe.

358. Of Dry fruits, there is a greater diversity of kinds having distinct names. The indehiscent sorts are commonly one-seeded.

359. **The Akene** or **Achenium** is a small, dry and indehiscent one-seeded fruit, often so seed-like in appearance that it is popularly taken for a naked seed.

The fruit of the Buttercup or Crowfoot is a good example, Fig. 376, 377. Its nature, as a ripened pistil (in this



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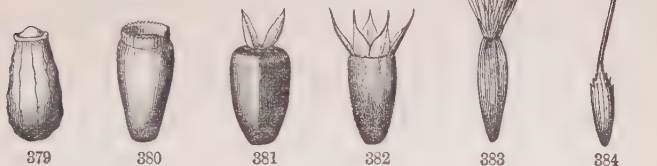
FIG. 375. Longitudinal section of a peach, showing flesh, stone, and seed.

FIG. 376. Akene of a Buttercup. 377. The same, divided lengthwise, to show the contained seed.

FIG. 378. Akene of Virgin's-bower, retaining the feathery style, which aids in dissemination.

case a simple carpel), is apparent by its bearing the remains of a style or stigma, or a scar from which this has fallen. It may retain the style and use it in various ways for dissemination (Fig. 378).

360. The fruit of *Compositæ* (though not of a single carpel) is also an akene. In this case the pericarp is invested by an adherent calyx-tube; the limb of which, when it has any, is called the *PAPPUS*. This name was first given to the down like that of the Thistle, but is applied to all forms under which the limb of the calyx of the "compound flower" appears. In Lettuce, Dandelion (Fig.



384), and the like, the acheneum as it matures tapers upwards into a slender beak, like a stalk to the pappus.

361. A *Cremocarp* (Fig. 385), a name given to the fruit of *Umbelliferae*, consists as it were of a pair of akenes united completely in the blossom, but splitting apart when ripe into the two closed carpels. Each of these is a *Meri-carp* or *Hemicarp*, names seldom used.



362. A *Utricle* is the same as an akene, but with a thin and bladdery loose pericarp; like that of the Goosefoot or Pigweed (Fig. 386). When ripe it may burst open irregularly to discharge the seed; or it may open by a circular line all round, the upper part falling off like a lid; as in the Amaranth (Fig. 387).



363. A *Caryopsis*, or *Grain*, is like an akene with the seed adhering to the thin pericarp throughout, so



that fruit and seed are incorporated into one body; as in wheat, Indian corn, and other kinds of grain.

364. A *Nut* is a dry and indehiscent fruit, commonly one-celled and one.

FIG. 379. Akene of Mayweed (no pappus). 380. That of Succory (its pappus a shallow cup). 381. Of Sunflower (pappus of two deciduous scales). 382. Of Sneezeweed (*Helenium*), with its pappus of five scales. 383. Of Sow-Thistle, with its pappus of delicate downy hairs. 384. Of the Dandelion, its pappus raised on a long beak.

FIG. 385. Fruit (cremocarp) of *Osmorrhiza*; the two akene-like ripe carpels separating at maturity from a slender axis or carpophore.

FIG. 386. Utricle of the common Pigweed (*Chenopodium album*).

FIG. 387. Utricle (pyxis) of Amaranth, opening all round (circumscissile).

seeded, with a hard, crustaceous, or bony wall, such as the cocoanut, hazelnut, chestnut, and the acorn (Fig. 37, 388.) Here the involucre, in the form of a cup at the base, is called the **CUPULE**. In the Chestnut the cupule forms the bur; in the Hazel, a leafy husk.



388

365. A **Samara**, or **Key-fruit**, is either a nut or an akene, or any other indehiscent fruit, furnished with a wing, like that of Ash (Fig. 389), and Elm (Fig. 390). The Maple-fruit is a pair of keys (Fig. 391).

366. **Dehiscent Fruits**, or **Pods**, are of two classes, viz., those of a simple pistil or carpel, and those of a compound pistil. Two common sorts of the first are named as follows:—

367. The **Follicle** is a fruit of a simple carpel, which dehisces down one side only, i. e. by the inner or ventral suture. The fruits of Marsh Marigold (Fig. 392), Pæony, Larkspur, and Milkweed are of this kind.

368. The **Legume** or true Pod, such as the peapod (Fig. 393), and the fruit of the Leguminous or Pulse family generally, is one which opens along the dorsal as well as the ventral suture. The two pieces



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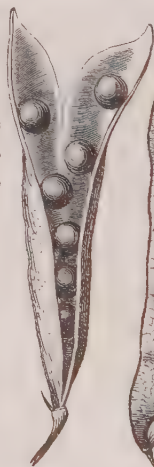
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into which it splits are called **VALVES**. A **LOMENT** is a legume which is constricted between the seeds, and at length breaks up crosswise into distinct joints, as in Fig. 394.

369. The pods or dehiscent fruits belonging to a compound ovary have several technical names: but they all may be regarded as kinds of

370. The **Capsule**, the dry and dehiscent fruit of any compound pistil. The capsule may discharge its seeds through chinks or pores, as in the

FIG. 388. Nut (acorn) of the Oak, with its cup or cupule.

FIG. 389. Samara or key of the White Ash, winged at end. 390. Samara of the American Elm, winged all round.

FIG. 391. Pair of samaras of Sugar Maple.

FIG. 392. Follicle of Marsh Marigold (*Caltha palustris*).

FIG. 393. Legume of a Sweet Pea, opened.

FIG. 394. Loment or jointed legume of a Tick-Trefoil (*Desmodium*).

Poppy, or burst irregularly in some part, as in *Lobelia* and the Snapdragon; but commonly it splits open (or is *dehiscent*) lengthwise into regular pieces, called VALVES.

371. Regular *Dehiscence* in a capsule takes place in two ways, which are best illustrated in pods of two or three cells. It is either

Loculicidal, or, splitting directly into the *loculi* or cells, that is, down the back (or the dorsal suture) of each cell or carpel, as in *Iris* (Fig. 395); or

Septicidal, that is, splitting through the partition or *septa*, as in *St. John's-wort* (Fig. 396), *Rhododendron*, etc. This divides the capsule into its component carpels, which then open by their ventral suture.

372. In *loculicidal dehiscence* the valves naturally bear the partitions on their middle; in the *septicidal*, half the thickness of a partition is borne on the margin of each valve. See the annexed diagrams. A variation of either mode occurs when the valves break away from the partitions, these remaining attached in the axis of the fruit. This is called *Sepifragal dehiscence*. One form is seen in the *Morning-Glory* (Fig. 400).

373. The capsules of *Rue*, *Spurge*, and some others, are both *loculicidal* and *septicidal*, and so split into half-carpellary valves or pieces.

374. The *Silique* (Fig. 401) is the technical name of the peculiar pod of the *Mustard* family; which is two-celled by a false partition stretched across between two parietal placentæ. It generally opens by two valves from below upward, and the placentæ with the partition are left behind when the valves fall off.

375. A *Silicle* or *Pouch* is only a short and broad *silique*, like that of the *Shepherd's Purse*, Fig. 402, 403.

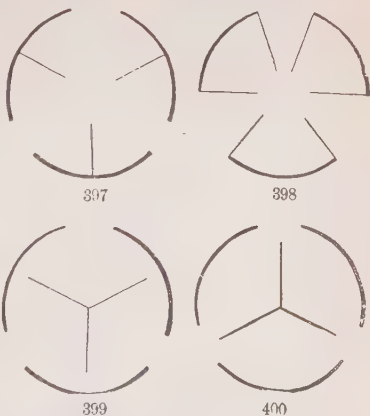
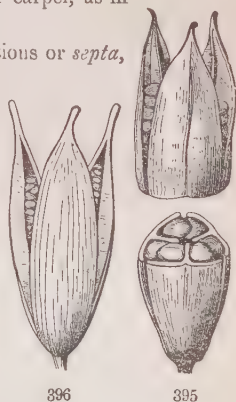


FIG. 395. Capsule of *Iris*, with *loculicidal dehiscence*; below, cut across.

FIG. 396. Pod of a *Marsh St. John's-wort*, with *septicidal dehiscence*.

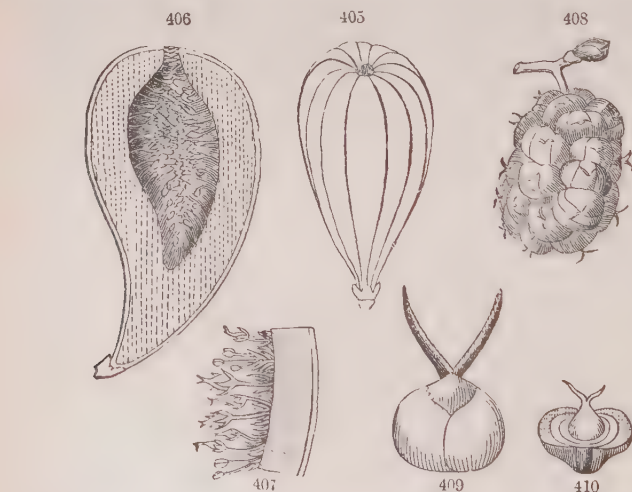
FIG. 397, 398. Diagrams of the two modes.

FIG. 399. Diagram of *septicidal dehiscence* of the *loculicidal* type. 400. Same of the *septicidal* or *marginal* type.

376. The **Pyxis** is a pod which opens by a circular horizontal line, the upper part forming a lid, as in Purslane (Fig. 404), the Plantain, Henbane, etc. In these the dehiscence extends all round, or is *circumscissile*. So it does in Amaranth (Fig. 387), forming a one-seeded utricular pyxis. In *Jeffersonia*, the line does not separate quite round, but leaves a portion for a hinge to the lid.

377. Of Multiple or Collective Fruits, which are properly masses of fruits aggregated into one body (as is seen in the Mulberry (Fig. 408), Pineapple, etc.), there are two kinds with special names and of peculiar structure.

378. The **Syconium** or **Fig-fruit** (Fig. 405, 406) is a fleshy axis or summit of stem, hollowed out, and lined within by a multitude of minute flowers, the whole becoming pulpy, and in the common fig, luscious.



379. The **Strobile** or **Cone** (Fig. 411), is the peculiar multiple fruit of Pines, Cypressess, and the like; hence named *Coniferae*, viz. cone-bearing

FIG. 401. Silique of a Cadamine or Spring Cress.

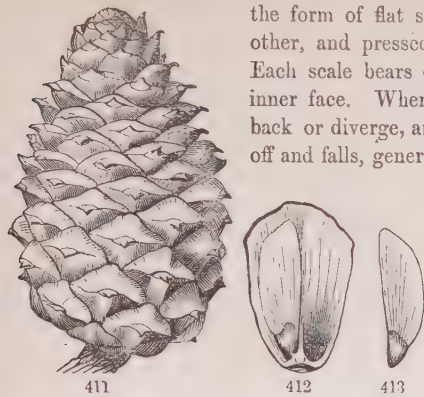
FIG. 402. Silicle of Shepherd's Purse. 403. Same, with one valve removed.

FIG. 404. Pyxis of Purslane, the lid detaching.

FIG. 405. A fig-fruit when young. 406. Same in section. 407. Magnified portion, a slice, showing some of the flowers.

FIG. 408. A mulberry. 409. One of the grains younger, enlarged; seen to be a pistillate flower with calyx becoming fleshy. 410. Same, with fleshy calyx cut across.

plants. As already shown (313), these cones are *open pistils*, mostly in the form of flat scales, regularly overlying each other, and pressed together in a spike or head. Each scale bears one or two naked seeds on its inner face. When ripe and dry, the scales turn back or diverge, and in the Pine the seed peels off and falls, generally carrying with it a wing, a part of the lining of the scale, which facilitates the dispersion of the seeds by the wind (Fig. 412, 413). In *Arbor-Vitæ*, the scales of the small cone are few, and not very unlike the leaves. In *Cypress* they are very thick at the top and narrow at the base, so as to make a peculiar sort of closed cone. In *Juniper* and *Red Cedar*, the few scales of the very small cone become fleshy, and ripen into a fruit which closely resembles a berry.



SECTION XV. THE SEED.

330. Seeds are the final product of the flower, to which all its parts and offices are subservient. Like the ovule from which it originates, a seed consists of coats and kernel.

381. The Seed-coats are commonly two (320), the outer and the inner. Fig. 414 shows the two, in a seed cut through lengthwise. The outer coat is often hard or crustaceous, whence it is called the *Testa*, or shell of the seed; the inner is almost always thin and delicate.

382. The shape and the markings, so various in different seeds, depend mostly on the outer coat. Sometimes this fits the kernel closely; sometimes it is expanded into a *wing*, as in the *Trumpet-Creeper* (Fig. 415), and occasionally this wing is cut up into shreds or tufts, as in the *Catalpa* (Fig. 416); or instead of a wing it may bear a *Coma*, or tuft of long and soft hairs, as in the *Milkweed* or *Silkweed* (Fig. 417). The use of wings, or downy tufts is to render the seeds buoyant



FIG. 411. Cone of a common Pitch Pine. 412. Inside view of a separated scale or open carpel; one seed in place: 413, the other seed.
FIG. 414. Seed of a Linden or Basswood cut through lengthwise, and magnified, the parts lettered: *a*, the hilum or scar; *b*, the outer coat; *c*, the inner; *d*, the albumen; *e*, the embryo.

for dispersion by the winds. This is clear, not only from their evident adaptation to this purpose, but also from the fact that winged and tufted seeds are found only in fruits that split open at maturity, never in those that remain closed. The coat of some seeds is beset with long hairs or wool. *Cotton*, one of the most important vegetable products, since it forms the principal clothing of the



415



416

larger part of the human race, consists of the long and woolly hairs which thickly cover the whole surface of the seed. There are also crests or other appendages of various sorts on certain seeds. A few seeds have an additional, but more or less incomplete covering, outside of the real seed-coats called an



417

383. **Aril, or Arillus.** The loose and transparent bag which encloses the seed of the White Water-Lily (Fig. 418) is of this kind. So is the *mace* of the nutmeg; and also the scarlet pulp around the seeds of the Waxwork (*Celastrus*) and Strawberry-bush (*Euonymus*). The aril is a growth from the extremity of the seed-stalk, or from the placenta when there is no seed-stalk.



418

384. A short and thickish appendage at or close to the hilum in certain seeds is called a **CARUNCLE** or **STROPHIOLE** (Fig. 419).

385. The various terms which define the position or direction of the ovule (erect, ascending, etc.) apply equally to the seed: so also the terms anatropous, orthotropous, campylotropous, etc., as already defined (320, 321), and such terms as

HILUM, or *Scar* left where the seed-stalk or funiculus falls away, or where the seed was attached directly to the placenta when there is no seed-stalk.



419

RHAPHÉ, the line or ridge which runs from the hilum to the chalaza in anatropous and amphitropous seeds.

CHALAZA, the place where the seed-coats and the kernel or nucleus are organically connected, — at the hilum in orthotropous and campylotropous seeds, at the extremity of the rhaphe or tip of the seed in other kinds.

MICROPYLE, answering to the *Foramen* or orifice of the ovule. Compare the accompanying figures and those of the ovules, Fig. 341-355.

FIG. 415. A winged seed of the Trumpet-Creeper.

FIG. 416. One of *Catalpa*, the kernel cut to show the embryo.

FIG. 417. Seed of Milkweed, with a *Coma* or tuft of long silky hairs at one end.

FIG. 418. Seed of White Water-Lily, enclosed in its aril.

FIG. 419. Seed of *Ricinus* or Castor-oil plant, with caruncle.

386. **The Kernel, or Nucleus**, is the whole body of the seed within the coats. In many seeds the kernel is all *Embryo*; in others a large part of it is the *Albumen*. For example, in Fig. 423, it is wholly embryo; in Fig. 422, all but the small speck (*g*) is albumen.

387. **The Albumen or Endosperm** of the seed is sufficiently characterized and its office explained in Sect. III., 31-35.

388. **The Embryo or Germ**, which is the rudimentary plantlet and the final result of blossoming, and its development in germination have been extensively illustrated in Sections II. and III. Its essential parts are the *Radicle* and the *Cotyledons*.

389. Its *Radicle* or *Caulicle* (the former is the term long and generally used in botanical descriptions, but the latter is the more correct one, for it is the initial stem, which merely gives origin to the root), as to its position in the seed, always points to and lies near the micropyle. In relation to the pericarp it is

Superior, when it points to the apex of the fruit or cell, and

Inferior, when it points to its base, or downward.

390. **The Cotyledons** have already been illustrated as respects their number, — giving the important distinction of *Dicotyledonous*, *Polycotyledonous* and *Monocotyledonous* embryos (36-43), — also as regards their thickness, whether *foliaceous* or *fleshy*; and some of the very various shapes and adaptations to the seed have been figured. They may be straight, or folded, or rolled up. In the latter case the cotyledons may be rolled up as it were from one margin, as in *Calycanthus* (Fig. 424), or from apex to base in a flat spiral, or they may be both folded (*plicate*) and rolled up (*convolute*), as in *Sugar Maple* (Fig. 11.) In one very natural family, the *Cruciferae*, two different modes prevail in the way the two cotyledons are brought round against the radicle. In one series they are



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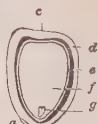
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423



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FIG. 420. Seed of a Violet (anatropous): *a*, hilum; *b*, raphe; *c*, chalaza.

FIG. 421. Seed of a Larkspur (also anatropous); the parts lettered as in the last.

FIG. 422. The same, cut through lengthwise: *a*, the hilum; *c*, chalaza; *d*, outer seed-coat; *e*, inner seed-coat; *f*, the albumen; *g*, the minute embryo.

FIG. 423. Seed of a St. John's-wort, divided lengthwise; here the seed whole kernel is embryo.

FIG. 424. Embryo of *Calycanthus*; upper part cut away, to show the convolute cotyledons.

FIG. 425. Seed of Bitter Cress, *Barbarea*, cut across to show the accumbent cotyledons. 426. Embryo of same, whole.

Accumbent, that is, the edges of the flat cotyledons lie against the radicle, as in Fig. 425, 426. In another they are

Incumbent, or with the plane of the cotyledons brought up in the opposite direction, so that the back of one of them lies against the radicle, as shown in Fig. 427, 428.



427



428

391. As to the situation of the embryo with respect to the albumen of the seed, when this is present in any quantity, the embryo may be *Axile*, that is occupying the axis or centre, either for most of its length, as in Violet (Fig. 429), Barberry (Fig. 48), and

Pine (Fig. 56); and in these it is straight.

But it may be variously curved or coiled in the albumen, as in Helianthemum (Fig. 430), in a Potato-seed (Fig. 50), or Onion-seed (Fig. 60), and Linden (Fig. 414); or it may be coiled around



429



430



430 a

the outside of the albumen, partly or into a circle, as in Chickweed (Fig. 431, 432) and in Mirabilis (Fig. 52). The latter mode prevails in Campylo-

tropous seeds. In the cereal grains, such as Indian Corn (Fig. 67) and Rice, 430 a, and in all other Grasses, the embryo is straight and applied to the outside of the abundant albumen.



431



432

392. The matured seed, with embryo ready to germinate and reproduce the kind, completes the cycle of the vegetable life in a phanerogamous plant, the account of which began with the seed and seedling

SECTION XVI. VEGETABLE LIFE AND WORK.

393. The following simple outlines of the anatomy and physiology of plants (3) are added to the preceding structural part for the better preparation of students in descriptive and systematic botany; also to give to all learners some general idea of the life, growth, intimate structure, and action of the beings which compose so large a part of organic nature. Those who would extend and verify the facts and principles here outlined will use the Physiological Botany of the "Botanical Text Book," by Professor Goodale, or some similar book.

FIG. 427. Seed of a *Sisymbrium*, cut across to show the incumbent cotyledons. 428. Embryo of the same, detached whole.

FIG. 429. Section of seed of Violet; anatropous with straight axile embryo in the albumen. 430. Section of seed of Rock Rose, *Helianthemum Canadense*; orthotropous, with curved embryo in the albumen. 430 a. Section of a grain of Rice, lengthwise, showing the embryo outside the albumen, which forms the principal bulk.

FIG. 431. Seed of a Chickweed, campylotropous. 432. Section of same, showing slender embryo coiled around the outside of the albumen of the kernel.

§ 1. ANATOMICAL STRUCTURE AND GROWTH.

394. **Growth** is the increase of a living thing in size and substance. It appears so natural that plants and animals should grow, that one rarely thinks of it as requiring explanation. It seems enough to say that a thing is so because it grew so. Growth from the seed, the germination and development of an embryo into a plantlet, and at length into a mature plant (as illustrated in Sections II. and III.), can be followed by ordinary observation. But the embryo is already a miniature plantlet, sometimes with hardly any visible distinction of parts, but often one which has already made very considerable growth in the seed. To investigate the formation and growth of the embryo itself requires well-trained eyes and hands, and the expert use of a good compound microscope. So this is beyond the reach of a beginner.

395. Moreover, although observation may show that a seedling, weighing only two or three grains, may double its bulk and weight every week of its early growth, and may in time produce a huge amount of vegetable matter, it is still to be asked what this vegetable matter is, where it came from, and by what means plants are able to increase and accumulate it, and build it up into the fabric of herbs and shrubs and lofty trees.

396. **Protoplasm.** All this fabric was built up under life, but only a small portion of it is at any one time alive. As growth proceeds, life is passed on from the old to the new parts, much as it has passed on from parent to offspring, from generation to generation in unbroken continuity. *Protoplasm* is the common name of that plant-stuff in which life essentially resides. All growth depends upon it; for it has the peculiar power of growing and multiplying and building up a living structure, — the animal no less than the vegetable structure, for it is essentially the same in both. Indeed, all the animal protoplasm comes primarily from the vegetable, which has the prerogative of producing it; and the protoplasm of plants furnishes all that portion of the food of animals which forms their flesh and living fabric.

397. The very simplest plants (if such may specifically be called plants rather than animals, or one may say, the simplest living things) are mere particles, or pellets, or threads, or even indefinite masses of protoplasm of vague form, which possess powers of motion or of changing their shape, of imbibing water, air, and even other matters, and of assimilating these into plant-stuff for their own growth and multiplication. Their growth is increase in substance by incorporation of that which they take in and assimilate. Their multiplication is by spontaneous division of their substance or body into two or more, each capable of continuing the process.

398. The embryo of a phanerogamous plant at its beginning (344) is essentially such a globule of protoplasm, which soon constricts itself into two and more such globules, which hold together inseparably in a row; then the last of the row divides without separation in the two other planes, to

form a compound mass, each grain or globule of which goes on to double itself as it grows; and the definite shaping of this still increasing mass builds up the embryo into its form.

399. Cell-walls. While this growth was going on, each grain of the forming structure formed and clothed itself with a coat, thin and transparent, of something different from protoplasm, — something which hardly



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and only transiently, if at all, partakes of the life and action. The protoplasm forms the living organism; the coat is a kind of protective covering or shell. The protoplasm, like the flesh of animals which it gives rise to, is composed of four chemical elements: Carbon, Hydrogen, Oxygen, and Nitrogen. The coating is of the nature of wood (is, indeed, that which makes wood), and has only the three elements, Carbon, Hydrogen, and Oxygen, in its composition.

400. Although the forming structure of an embryo in the fertilized ovule is very minute and difficult to see, there are many simple plants of lowest grade, abounding in pools of water, which more readily show the earlier stages or simplest states of plant-growth. One of these, which is common in early spring, requires only moderate magnifying power to bring to view what is shown in Fig. 437. In a slimy mass which holds all loosely together, little spheres of green vegetable matter are seen, assembled in fours, and these fours themselves in clusters of fours. A transient inspection shows, what prolonged watching would confirm, that each sphere divides first in one plane, then in the other, to

make four, soon acquiring the size of the original, and so on, producing successive groups of fours. These pellets each form on their surface a transparent wall, like that just described. The delicate wall is for some time capable of expansive growth, but is from the first much firmer than the protoplasm within; through it the latter imbibes surrounding moisture, which becomes a watery sap, occupying vacuities in the protoplasmic mass which enlarge or run together as the periphery increases and distends. When full grown the protoplasm may become a mere lining to the wall, or some of it central, as a nucleus, this usually connected with the wall-lining by delicate threads of the same substance. So, when full grown, the wall with its lining—a vesicle, containing liquid or some



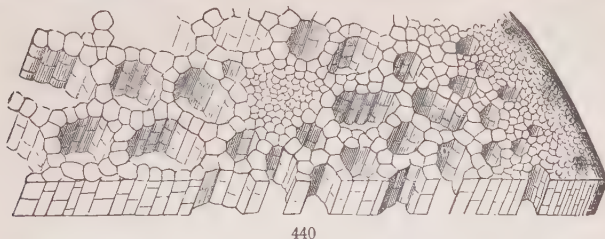
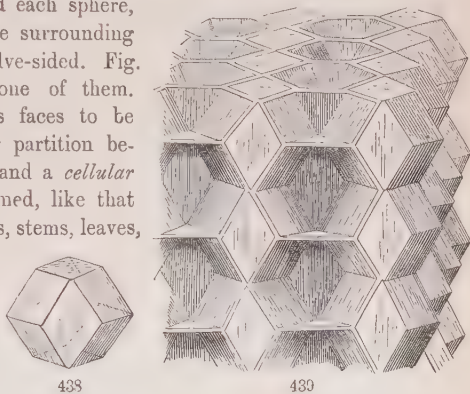
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FIG. 433–436. Figures to illustrate the earlier stages in the formation of an embryo; a single mass of protoplasm (Fig. 433) dividing into two, three, and then into more incipient cells, which by continued multiplication build up an embryo.

FIG. 437. Magnified view of some of a simple fresh water Alga, the *Tetraspora lubrica*, each sphere of which may answer to an individual plant.

solid matters and in age mostly air — naturally came to be named a **CELL**. But the name was suggested by, and first used only for, cells in combination or built up into a fabric, much as a wall is built of bricks, that is, into a

401. **Cellular Structure or Tissue.** Suppose numerous cells like those of Fig. 437 to be heaped up like a pile of cannon-balls, and as they grew, to be compacted together while soft and yielding; they would flatten where they touched, and each sphere, being touched by twelve surrounding ones would become twelve-sided. Fig. 438 would represent one of them. Suppose the contiguous faces to be united into one wall or partition between adjacent cavities, and a *cellular structure* would be formed, like that shown in Fig. 439. Roots, stems, leaves, and the whole of phanerogamous plants are a fabric of countless numbers of such cells. No such exact regularity in size and shape is ever actually found; but a nearly truthful magnified view of a small portion of a slice of the flower-stalk of a Calla Lily (Fig. 440) shows a fairly corres-



ponding structure; except that, owing to the great air-spaces of the interior, the fabric may be likened rather to a stack of chimneys than to a solid fabric. In young and partly transparent parts one may discern the cellular structure by looking down directly on the surface, as of a forming root. (Fig. 82, 441, 442).

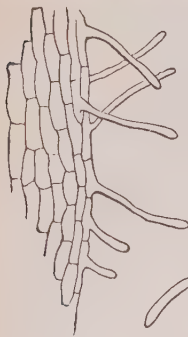
402. The substance of which cell-walls are mainly composed is called **CELLULOSE**. It is essentially the same in the stem of a delicate leaf or petal and in the wood of an Oak, except that in the latter the walls are

FIG. 438. Diagram of a vegetable cell, such as it would be if when spherical it were equally pressed by similar surrounding cells in a heap.

FIG. 439. Ideal construction of cellular tissue so formed, in section.

FIG. 440. Magnified view of a portion of a transverse slice of stem of Calla Lily. The great spaces are tubular air-channels built up by the cells.

much thickened and the calibre small. The protoplasm of each living cell appears to be completely shut up and isolated in its shell of cellulose; but microscopic investigation has brought to view, in many cases, minute threads of protoplasm which here and there traverse the cell-wall through minute pores, thus connecting the living portion of one cell with that of adjacent cells. (See Fig. 447, &c.)



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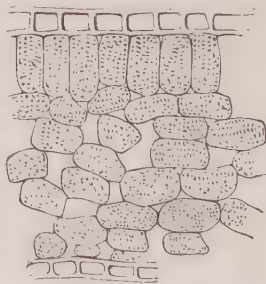
403. The hairs of plants are cells formed on the surface; either elongated single cells (like the root-hairs of Fig. 441, 442), or a row of shorter cells. Cotton fibres are long and simple cells growing from the surface of the seed.

404. The size of the cells of which common plants are made up varies from about the thirtieth to the thousandth of an inch in diameter. An ordinary size of short or roundish

cells is from $\frac{1}{300}$ to $\frac{1}{500}$ of an inch; so that there may generally be from 27 to 125 millions of cells in the compass of a cubic inch!

405. Some parts are built up as a compact structure; in others cells are arranged so as to build up regular air-channels, as in the stems of aquatic and other water-loving plants (Fig. 410), or to leave irregular spaces, as in the lower part of most leaves, where the cells only here and there come into close contact (Fig. 443).

406. All such soft cellular tissue, like this of leaves, that of pith, and of the green bark, is called PARENCHYMA, while fibrous and woody parts are composed of PROSENCHYMA, that is, of peculiarly transformed



443

407. Strengthening Cells. Common cellular tissue, which makes up the whole structure of all very young plants, and the whole of Mosses and other vegetables of the lowest grade, even when full grown, is too tender or too brittle to give needful strength and toughness for plants which are to rise to any considerable height and support themselves. In these needful strength is imparted, and the conveyance of sap through the plant is facilitated, by the change, as they are formed, of some cells into thicker-walled and tougher tubes, and by the running together of some of

FIG. 441. Much magnified small portion of young root of a seedling Maple (such as of Fig. 82); and 442, a few cells of same more magnified. The prolongations from the back of some of the cells are root-hairs.

FIG. 443. Magnified section through the thickness of a leaf of Florida Star-Anise.

these, or the prolongation of others, into hollow fibres or tubes of various size. Two sorts of such transformed cells go together, and essentially form the

408. **Wood.** This is found in all common herbs, as well as in shrubs and trees, but the former have much less of it in proportion to the softer cellular tissue. It is formed very early in the growth of the root, stem, and leaves, — traces of it appearing in large embryos even while yet in the seed. Those cells that lengthen, and at the same time thicken their walls form the proper **WOODY FIBRE** or **WOOD-CELLS**; those of larger size and thinner walls, which are thickened only in certain parts so as to have peculiar markings, and which often are seen to be made up of a row of cylindrical cells, with the partitions between absorbed or broken away, are called **DUCTS**, or sometimes **VESSELS**. There are all gradations between wood-cells and ducts, and between both these and common cells. But in most plants the three kinds are fairly distinct.

409. The proper cellular tissue, or *parenchyma*, is the ground-work of root, stem, and leaves; this is traversed, chiefly lengthwise, by the strengthening and conducting tissue, wood-cells and duct-cells, in the form of bundles or threads, which, in the stems and stalks of herbs are fewer and comparatively scattered, but in shrubs and trees so numerous and crowded that in the stems and all permanent parts they make a solid mass of wood. They extend into and ramify in the leaves, spreading out in a horizontal plane, as the framework of ribs and veins, which supports the softer cellular portion or parenchyma.

410. **Wood-Cells, or Woody Fibres,** consist of tubes, commonly between one and two thousandths, but in Pine-wood sometimes two or three hundredths, of an inch in diameter. Those from the tough bark of the Basswood,

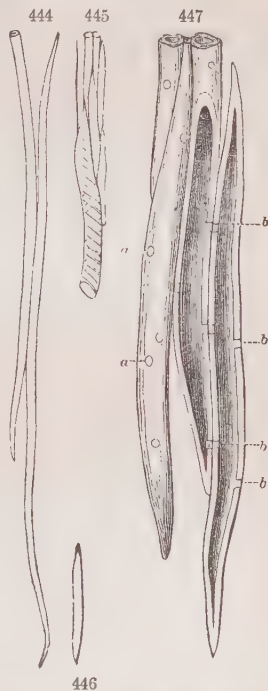


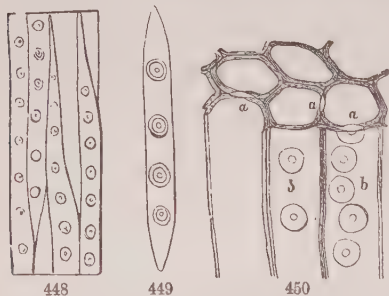
FIG. 444. Magnified wood-cells of the bark (bast-cells) of Basswood, one and part of another. 445. Some wood-cells from the wood (and below part of a duct); and 446, a detached wood-cell of the same; equally magnified.

FIG. 447. Some wood-cells from Buttonwood, *Platanus*, highly magnified, a whole cell and lower end of another on the left; a cell cut half away lengthwise, and half of another on the right; some pores or pits (*a*) seen on the left; while *b b* mark sections through these on the cut surface. When living and young the protoplasm extends into these and by minuter perforations connects across them. In age the pits become open passages, facilitating the passage of sap and air.

shown in Fig. 444, are only the fifteen-hundredth of an inch wide. Those of Buttonwood (Fig. 447) are larger, and are here highly magnified besides. The figures show the way wood-cells are commonly put together, namely, with their tapering ends overlapping each other, — spliced together, as it were, — thus giving more strength and toughness. In hard-woods, such as Hickory and Oak, the walls of these tubes are very thick, as well as dense; while in soft woods, such as White-Pine and Basswood, they are thinner.

411. Wood-cells in the bark are generally longer, finer, and tougher than those of the proper wood, and appear more like fibres. For example, Fig. 446 represents a cell of the wood of Basswood of average length, and Fig. 444 one (and part of another) of the fibrous bark, both drawn to the same scale. As these long cells form the principal part of fibrous bark, or *bast*, they are named *Bast-cells* or *Bast-fibres*. These give the great toughness and flexibility to the inner bark of Basswood (i. e. Bast-wood) and of Leatherwood; and they furnish the invaluable fibres of flax and hemp;

the proper wood of their stems being tender, brittle, and destroyed by the processes which separate for use the tough and slender bast-cells. In Leatherwood (*Dirca*) the bast-cells are remarkably slender. A view of one, if magnified on the scale of Fig. 444, would be a foot and a half long.



412. The wood-cells of Pines, and more or less of all other Coniferous trees, have on two of their sides very peculiar disk-shaped markings (Fig. 448-450) by which that kind of wood is recognizable.

413. Ducts, also called **VESSELS**, are mostly larger than wood-cells: indeed, some of them, as in Red Oak, have calibre large enough to be discerned on a cross section by the naked eye. They make the visible porosity of such kinds of wood. This is particularly the case with

Dotted ducts (Fig. 451, 452), the surface of which appears as if riddled with round or oval pores. Such ducts are commonly made up of a row of large cells more or less confluent into a tube.

Scalariform ducts (Fig. 453, 459), common in Ferns, and generally angled by mutual pressure in the bundles,

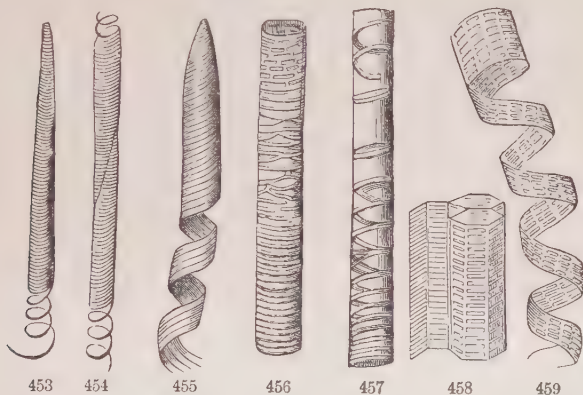


FIG. 448. Magnified bit of a pine-shaving, taken parallel with the silver grain. 449. Separate whole wood-cell, more magnified. 450. Same, still more magnified: both sections represented: *a*, disks in section, *b*, in face.

FIG. 451, 452. A large and a smaller dotted duct from Grape-Vine.

have transversely elongated thin places, parallel with each other, giving a ladder-like appearance, whence the name.

Annular ducts (Fig. 457) are marked with cross lines or rings, which are thickened portions of the cell-wall.



Spiral ducts or vessels (Fig. 453-455) have thin walls, strengthened by a spiral fibre adherent within. This is as delicate and as strong as spider-web: when uncoiled by pulling apart, it tears up and annihilates the cell-wall. The uncoiled threads are seen by gently pulling apart many leaves, such as those of *Amaryllis*, or the stalk of a Strawberry leaflet.

Laticiferous ducts, Vessels of the Latex, or Milk-vessels are peculiar branching tubes which hold *latex* or milky juice in certain plants. It is very difficult to see them, and more so to make out their nature. They are peculiar in branching and inosculating, so as to make a net-work of tubes, running in among the cellular tissue; and they are very small, except when gorged and old (Fig. 460, 461).

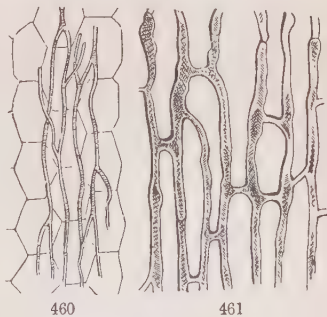


FIG. 453, 454. Spiral ducts which uncoil into a single thread. 455. Spiral duct which tears up as a band. 456. An annular duct, with variations above. 457. Loose spiral duct passing into annular. 458. Scalariform ducts of a Fern; part of a bundle, prismatic by pressure. 459. One torn into a band.

FIG. 460. Milk Vessels of Dandelion, with cells of the common cellular tissue. 461. Others from the same older and gorged with milky juice. All highly magnified.

§ 2. CELL-CONTENTS.

414. The living contents of young and active cells are mainly protoplasm with water or watery sap which this has imbibed. Old and effete cells are often empty of solid matter, containing only water with whatever may be dissolved in it, or air, according to the time and circumstances. All the various products which plants in general elaborate, or which particular plants specially elaborate, out of the common food which they derive from the soil and the air, are contained in the cells, and in the cells they are produced.

415. *Sap* is a general name for the principal liquid contents, — *Crude sap*, for that which the plant takes in, *Elaborated sap* for what it has digested or assimilated. They must be undistinguishably mixed in the cells.

416. Among the solid matters into which cells convert some of their elaborated sap two are general and most important. These are *Chlorophyll* and *Starch*.

417. *Chlorophyll* (meaning *leaf-green*) is what gives the green color to herbage. It consists of soft grains of rather complex nature, partly wax-like, partly protoplasmic. These abound in the cells of all common leaves and the green rind of plants, wherever exposed to the light. The green color is seen through the transparent skin of the leaf and the walls of the containing cells. *Chlorophyll* is essential to ordinary assimilation in plants: by its means, under the influence of sunlight, the plant converts crude sap into vegetable matter.

418. Far the largest part of all vegetable matter produced is that which goes to build up the plant's fabric or cellular structure, either directly or indirectly. There is no one good name for this most important product of vegetation. In its final state of cell-walls, the permanent fabric of herb and shrub and tree, it is called *Cellulose* (408): in its most soluble form it is *Sugar* of one or another kind; in a less soluble form it is *Dextrine*, a kind of liquefied starch: in the form of solid grains stored up in the cells it is *Starch*. By a series of slight chemical changes (mainly a variation in the water entering into the composition), one of these forms is converted into another.

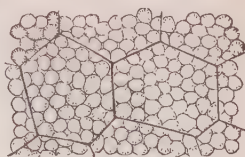
419. *Starch* (*Farina* or *Fecula*) is the form in which this common plant material is, as it were, laid by for future use. It consists of solid grains, somewhat different in form in different plants, in size varying from $\frac{1}{800}$ to $\frac{1}{4000}$ of an inch, partly translucent when wet, and of a pearly lustre. From the concentric lines, which commonly appear under the microscope, the grains seem to be made up of layer over layer. When loose they are commonly oval, as in potato-starch (Fig. 462): when much compacted the grains may become angular (Fig. 463).

420. The starch in a potato was produced in the foliage. In the soluble form of dextrine, or that of sugar, it was conveyed through the cells of the herbage and stalks to a subterranean shoot, and there stored up in the

tuber. When the potato sprouts, the starch in the vicinity of developing buds or eyes is changed back again, first into mucilaginous dextrine, then into sugar, dissolved in the sap, and in this form it is made to flow to the growing parts, where it is laid down into cellulose or cell-wall.



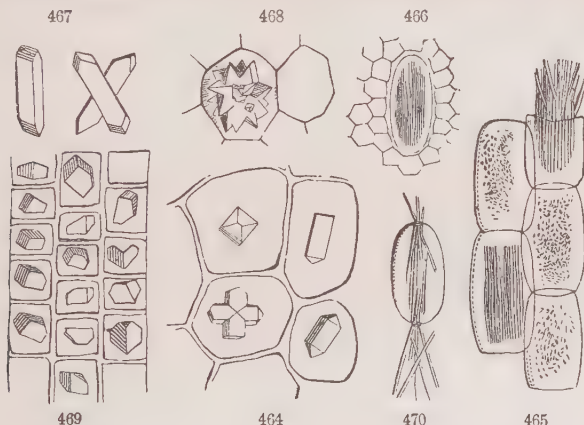
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421. Besides these cell-contents which are in obvious and essential relation to nutrition, there are others the use of which is problematical. Of such the commonest are

422. **Crystals.** These when slender or needle-shaped are called RHAPHIDES. They are of inorganic matter, usually of oxalate or phosphate or sulphate of lime. Some, at least of the latter, may be direct crystalliza-



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tions of what is taken in dissolved in the water absorbed, but others must be the result of some elaboration in the plant. Some plants have hardly any; others abound in them, especially in the foliage and bark. In Locust-bark almost every cell holds a crystal; so that in a square inch not thicker than writing-paper there may be over a million and a half of them. When

FIG. 462. Some magnified starch-grains, in two cells of a potato. 463. Some cells of the albumen or floury part of Indian Corn, filled with starch-grains.

FIG. 464. Four cells from dried Onion-peel, each holding a crystal of different shape, one of them twinned. 465. Some cells from stalk of Rhubarb-plant, three containing chlorophyll; two (one torn across) with raphides. 466. Raphides in a cell, from *Arisæma*, with small crystals surrounding. 467. Prismatic crystals from the bark of Hickory. 468. Glomerate crystal in a cell, from Beet-root. 469. A few cells of Locust-bark, a crystal in each. 470. A detached cell, with raphides being forced out, as happens when put in water.

needle-shaped (rhaplides), as in stalks of Calla-Lily, Rhubarb, or Four-o'clock, they are usually packed in sheaf-like bundles. (Fig. 465, 466.)

§ 3. ANATOMY OF ROOTS AND STEMS.

423. This is so nearly the same that an account of the internal structure of stems may serve for the root also.

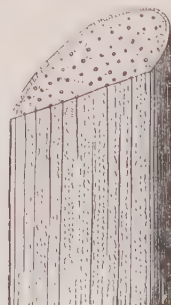
424. At the beginning, either in the embryo or in an incipient shoot from a bud, the whole stem is of tender cellular tissue or parenchyma. But wood (consisting of wood-cells and ducts or vessels) begins to be formed in the earliest growth; and is from the first arranged in two ways, making two general kinds of wood. The difference is obvious even in herbs, but is more conspicuous in the enduring stems of shrubs and trees.

425. On one or the other of these two types the stems of all planerogamous plants are constructed. In one, the wood is made up of separate threads, scattered here and there throughout the whole diameter of the stem. In the other, the wood is all collected to form a layer (in a slice across the stem appearing as a ring) between a central cellular part which has none in it, the *Pith*, and an outer cellular part, the *Bark*.

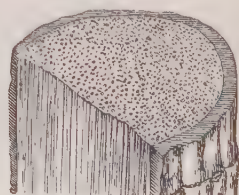
426. An Asparagus-shoot and a Corn-stalk for herbs, and a rattan for a woody kind, represent the first kind. To it



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belong all plants with monocotyledonous embryo (40). A Bean-stalk and the stem of any common shrub or tree represent the second; and

to it belong all plants with dicotyledonous or polycotyledonous embryo. The first has been called, not very properly, *Endogenous*, which means inside-growing; the second, properly enough, *Erogenous*, or outside-growing.

427. **Endogenous Stems**, those of Monocotyls (10), attain their greatest size and most characteristic development in Palms and Dragon-trees, therefore chiefly in warm climates, although the Palmetto and some

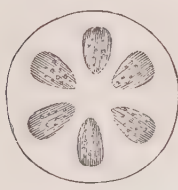
FIG. 471. Diagram of structure of Palm or Yucca. 472. Structure of a Corn-stalk, in transverse and longitudinal section. 473. Same of a small Palm-stem. The dots on the cross sections represent cut ends of the woody bundles or threads.

Yuccas become trees along the southern borders of the United States. In such stems the woody bundles are more numerous and crowded toward the circumference, and so the harder wood is outside; while in an exogenous stem the oldest and hardest wood is toward the centre. An endogenous stem has no clear distinction of pith, bark, and wood, concentrically arranged, no silver grain, no annual layers, no bark that peels off clean from the wood. Yet old stems of *Yuccas* and the like, that continue to increase in diameter, do form a sort of layers and a kind of scaly bark when old. *Yuccas* show well the curving of the woody bundles (Fig. 471) which below taper out and are lost at the rind.

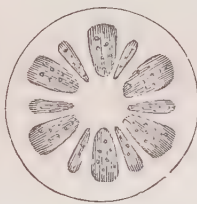
423. **Exogenous Stems**, those of Dicotyls (37), or of plants coming from dicotyledonous and also polycotyledonous embryos, have a structure which is familiar in the wood of our ordinary trees and shrubs. It is the same in an herbaceous shoot (such as a Flax-stem, Fig. 474) as in a Maple-stem of the first year's growth, except that the woody layer is commonly thinner or perhaps reduced to a circle of bundles. It was so in the tree-stem at the beginning. The wood all forms in a cylinder, — in cross section a ring — around a central cellular part, dividing the cellular core within, the pith, from a cellular bark without. As the wood-bundles increase in number and in size,



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they press upon each other and become wedge-shaped in the cross section; and they continue to grow from the outside, next the bark, so that they become very thin wedges or plates. Between the plates or wedges are very thin plates (in cross section lines) of much compressed cellular tissue, which connect the pith with the bark. The plan of a one-year-old woody stem of this kind is exhibited in the figures, which are essentially diagrams.

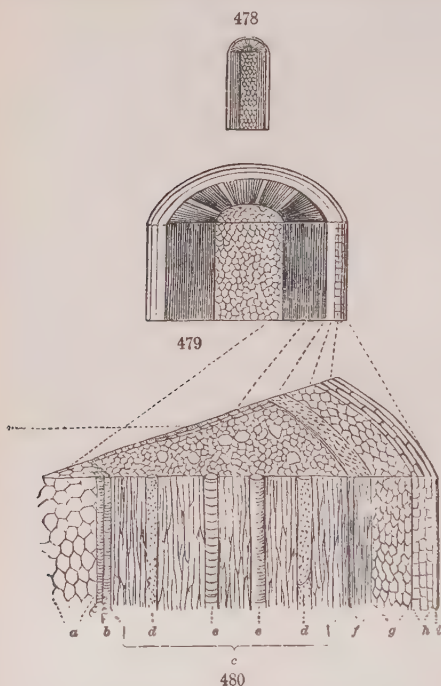
429. When such a stem grows on from year to year, it adds annually a

FIG. 474. Short piece of stem of Flax, magnified, showing the bark, wood, and pith in a cross section.

FIG. 475. Diagram of a cross section of a very young exogenous stem, showing six woody bundles or wedges. 476. Same later, with wedges increased to twelve. 477. Still later, the wedges filling the space, separated only by the thin lines, or medullary rays, running from pith to bark.

layer of wood outside the preceding one, between that and the bark. This is exogenous growth, or outside-growing, as the name denotes.

430. Some new bark is formed every year, as well as new wood, the



former inside, as the latter is outside of that of the year preceding. The ring or zone of tender forming tissue between the bark and the wood has been called the *Cambium Layer*. *Cambium* is an old name of the physiologists for nutritive juice. And this thin layer is so gorged with rich nutritive sap when spring growth is renewed, that the bark then seems to be loose from the wood and a layer of viscid sap (or *cambium*) to be poured out between the two. But there is all the while a connection of the bark and the wood by delicate cells, rapidly multiplying and growing.

431. The Bark of a year-old stem consists of

three parts, more or less distinct, namely, — beginning next the wood, —

1. THE LIBER or FIBROUS BARK, the *Inner Bark*. This contains some wood-cells, or their equivalent, commonly in the form of bast or bast-cells (411, Fig. 444), such as those of Basswood or Linden, and among herbs those of flax and hemp, which are spun and woven or made into cordage. It also contains cells which are named *sieve-cells*, on account of numerous slits and pores in their walls, by which the protoplasm of contiguous cells communicates. In woody stems, whenever a new layer of wood is formed, some new liber or inner bark is also formed outside of it.

FIG. 478. Piece of a stem of Soft Maple, of a year old, cut crosswise and lengthwise.

FIG. 479. A portion of the same, magnified.

FIG. 480. A small piece of the same, taken from one side, reaching from the bark to the pith, and highly magnified: *a*, a small bit of the pith; *b*, spiral ducts of what is called the *medullary sheath*; *c*, the wood; *d*, *d*, dotted ducts in the wood; *e*, *e*, annular ducts; *f*, the liber or inner bark; *g*, the green bark; *h*, the corky layer; *i*, the skin, or epidermis; *j*, one of the medullary rays, or plates of silver grain, seen on the cross-section.

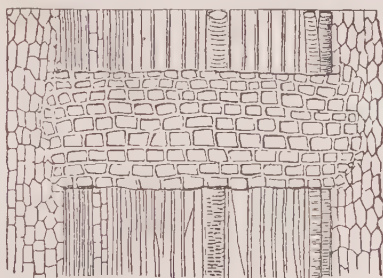
2. THE GREEN BARK or *Middle Bark*. This consists of cellular tissue only, and contains the same green matter (*chlorophyll*, 417) as the leaves. In woody stems, before the season's growth is completed, it becomes covered by

3. THE CORKY LAYER or *Outer Bark*, the cells of which contain no chlorophyll, and are of the nature of *cork*. Common cork is the thick corky layer of the bark of the Cork-Oak of Spain. It is this which gives to the stems or twigs of shrubs and trees the aspect and the color peculiar to each, — light gray in the Ash, purple in the Red Maple, red in several Dogwoods, etc.

4. THE EPIDERMIS, or skin of the plant, consisting of a layer of thick-sided empty cells, which may be considered to be the outermost layer, or in most herbaceous stems the only layer, of cork-cells.



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432. The green layer of bark seldom grows much after the first season. Sometimes the corky layer grows and forms new layers, inside of the old, for years, as in the Cork-Oak, the Sweet Gum-tree, and the White and the Paper Birch. But it all dies after a while; and the continual enlargement of the wood within finally stretches it more than it can bear, and sooner or later cracks and rends it, while the weather acts powerfully upon its surface; so the older bark perishes and falls away piecemeal year by year.

433. So on old trunks only the inner bark remains. This is renewed every year from within and so kept alive, while the older and outer layers die, are fissured and rent by the distending trunk, weathered and worn, and thrown off in fragments, — in some trees slowly, so that the bark of old trunks may acquire great thickness; in others, more rapidly. In Honey-suckles and Grape-Vines, the layers of liber loosen and die when only a year or two old. The annual layers of liber are sometimes as distinct as those of the wood, but often not so.

FIG. 481. Magnified view of surface of a bit of young Maple wood from which the bark has been torn away, showing the wood-cells and the bark-ends of medullary rays.

FIG. 482. Section in the opposite direction, from bark (on the left) to beginning of pith (on the right), and a medullary ray extending from one to the other.

434. **The Wood** of an exogenous trunk, having the old growths covered by the new, remains nearly unchanged in age, except from decay. Wherever there is an annual suspension and renewal of growth, as in temperate climates, the annual growths are more or less distinctly marked, in the form of concentric rings on the cross section, so that the age of the tree may be known by counting them. Over twelve hundred layers have been counted on the stumps of Sequoias in California, and it is probable that some trees now living antedate the Christian era.

435. The reason why the annual growths are distinguishable is, that the wood formed at the beginning of the season is more or less different in the size or character of the cells from that of the close. In Oak, Chestnut, etc., the first wood of the season abounds in dotted ducts, the calibre of which is many times greater than that of the proper wood-cells.

436. **Sap-wood, or Alburnum.** This is the newer wood, living or recently alive, and taking part in the conveyance of sap. Sooner or later, each layer, as it becomes more and more deeply covered by the newer ones and farther from the region of growth, is converted into

437. **Heart-wood, or Duramen.** This is drier, harder, more solid, and much more durable as timber, than sap-wood. It is generally of a different color, and it exhibits in different species the hue peculiar to each, such as reddish in Red-Cedar, brown in Black-Walnut, black in Ebony, etc. The change of sap-wood into heart-wood results from the thickening of the walls of the wood cells by the deposition of hard matter, lining the tubes and diminishing their calibre; and by the deposition of a vegetable coloring-matter peculiar to each species. The heart-wood, being no longer a living part, may decay, and often does so, without the least injury to the tree, except by diminishing the strength of the trunk, and so rendering it more liable to be overthrown.

438. **The Living Parts of a Tree,** of the exogenous kind, are only these: first, the rootlets at one extremity; second, the buds and leaves of the season at the other; and third, a zone consisting of the newest wood and the newest bark, connecting the rootlets with the buds or leaves, however widely separated these may be, — in the tallest trees from two to four hundred feet apart. And these parts of the tree are all renewed every year. No wonder, therefore, that trees may live so long, since they annually reproduce everything that is essential to their life and growth, and since only a very small part of their bulk is alive at once. The tree survives, but nothing now living has been so long. In it, as elsewhere, life is a transitory thing, ever abandoning the *old*, and renewed in the *young*.

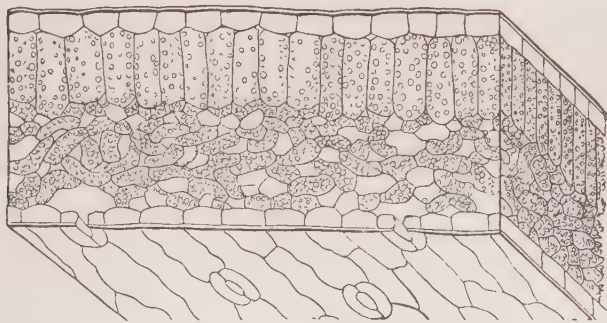
§ 4. ANATOMY OF LEAVES.

439. The wood in leaves is the framework of ribs, veins, and veinlets (125), serving not only to strengthen them, but also to bring in the sap, and to distribute it throughout every part. The cellular portion is the

green pulp, and is nearly the same as the green layer of the bark. So that the leaf may properly enough be regarded as a sort of expansion of the fibrous and green layers of the bark. It has no proper corky layer; but the whole is covered by a transparent skin or *epidermis*, resembling that of the stem.

440. The cells of the leaf are of various forms, rarely so compact as to form a close cellular tissue, usually loosely arranged, at least in the lower part, so as to give copious intervening spaces or air passages, communicating throughout the whole interior (Fig. 443, 483). The green color is given by the chlorophyll (417), seen through the very transparent walls of the cells and through the translucent epidermis of the leaf.

441. In ordinary leaves, having an upper and under surface, the green cells form two distinct strata, of different arrangement. Those of the upper stratum are oblong or cylindrical, and stand endwise to the surface of the leaf, usually close together, leaving hardly any vacant spaces; those of the lower are commonly irregular in shape, most of them with their longer diameter parallel to the face of the leaf, and are very loosely arranged, leaving many and wide air-chambers. The green color of the lower is therefore diluted, and paler than that of the upper face of the leaf. The upper part of the leaf is so constructed as to bear the direct action



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of the sunshine; the lower so as to afford freer circulation of air, and to facilitate transpiration. It communicates more directly than the upper with the external air by means of *Stomates*.

442. The *Epidermis* or skin of leaves and all young shoots is best seen in the foliage. It may readily be stripped off from the surface of a Lily-leaf, and still more so from more fleshy and soft leaves, such as those

FIG. 483. Magnified section of a leaf of White Lily, to exhibit the cellular structure, both of upper and lower stratum, the air-passages of the lower, and the epidermis or skin, in section, also a little of that of the lower face, with some of its stomates.

of Houseleek. The epidermis is usually composed of a single layer, occasionally of two or three layers, of empty cells, mostly of irregular outline. The sinuous lines which traverse it, and may be dis-



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cerned under low powers of the microscope (Fig. 487), are the boundaries of the epidermal cells.

443. Breathing-pores, or Stomates, Stomata (singular, a *Stoma*, — literally, a mouth) are openings through the epidermis into the air-chambers or intercellular passages, always between and guarded by a pair of thin-walled guardian cells. Although most abundant in leaves, especially on their lower face (that which is screened from direct sunlight), they are found on most other green parts. They establish a direct communication between the external air and that in the loose interior of the leaf. Their guardian cells or lips, which are soft and delicate, like those of the green pulp within, by their greater or less turgidity open or close the orifice as the moisture or dryness varies.

444. In the White Lily the stomata are so remarkably large that they may be seen by a simple microscope of moderate power, and may be discerned even by a good hand lens. There are about 60,000 of them to the square inch of the epidermis of the lower face of this Lily-leaf, and only about 3000 to the same space on the upper face. It is computed that an average leaf of an Apple-tree has on its lower face about 100,000 of these mouths.

§ 5. PLANT FOOD AND ASSIMILATION.

445. Only plants are capable of originating organizable matter, or the materials which compose the structure of vegetables and animals. The essential and peculiar work of plants is to take up portions of earth and air (water belonging to both) upon which animals cannot live at all, and to convert them into something organizable; that is, into something that, under life, may be built up into vegetable and animal structures. All the food of animals is produced by plants. Animals live upon vegetables,

FIG. 484. Small portion of epidermis of the lower face of a White-Lily leaf, with stomata.

FIG. 485. One of these, more magnified, in the closed state. 486. Another stoma, open.

FIG. 487. Small portion of epidermis of the Garden Balsam, highly magnified, showing very sinuous-walled cells, and three stomata.

directly or at second hand, the carnivorous upon the herbivorous; and vegetables live upon earth and air, immediately or at second hand.

446. The Food of plants, then, primarily, is earth and air. This is evident enough from the way in which they live. Many plants will flourish in pure sand or powdered chalk, or on the bare face of a rock or wall, watered merely with rain. And almost any plant may be made to grow from the seed in moist sand, and increase its weight many times, even if it will not come to perfection. Many naturally live suspended from the branches of trees high in the air, and nourished by it alone, never having any connection with the soil; and some which naturally grow on the ground, like the Live-forever of the gardens, when pulled up by the roots and hung in the air will often flourish the whole summer long.

447. It is true that fast-growing plants, or those which produce much vegetable matter in one season (especially in such concentrated form as to be useful as food for man or the higher animals) will come to maturity only in an enriched soil. But what is a rich soil? One which contains decomposing vegetable matter, or some decomposing animal matter; that is, in either case, some decomposing organic matter formerly produced by plants. Aided by this, grain-bearing and other important vegetables will grow more rapidly and vigorously, and make a greater amount of nourishing matter, than they could if left to do the whole work at once from the beginning. So that in these cases also all the organic or organizable matter was made by plants, and made out of earth and air. Far the larger and most essential part was air and water.

448. Two kinds of material are taken in and used by plants; of which the first, although more or less essential to perfect plant-growth, are in a certain sense subsidiary, if not accidental, viz.:—

Earthy constituents, those which are left in the form of ashes when a leaf or a stick of wood is burned in the open air. These consist of some *potash* (or *soda* in a marine plant), some *silex* (the same as flint), and a little *lime*, *alumine*, or *magnesia*, *iron* or *manganese*, *sulphur*, *phosphorus*, etc.,—some or all of these in variable and usually minute proportions. They are such materials as happen to be dissolved, in small quantity, in the water taken up by the roots; and when that is consumed by the plant, or flies off pure (as it largely does) by exhalation, the earthy matter is left behind in the cells,—just as it is left incrusting the sides of a teakettle in which much hard water has been boiled. Naturally, therefore, there is more earthy matter (i. e. more ashes) in the leaves than in any other part (sometimes as much as seven per cent, when the wood contains only two per cent); because it is through the leaves that most of the water escapes from the plant. Some of this earthy matter incrusts the cell-walls, some goes to form crystals or raphides, which abound in many plants (122), some enters into certain special vegetable products, and some appears to be necessary to the well-being of the higher orders of plants, although forming no necessary part of the proper vegetable structure.

The essential constituents of the organic fabric are those which are dissipated into air and vapor in complete burning. They make up from 88 to 99 per cent of the leaf or stem, and essentially the whole both of the cellulose of the walls and the protoplasm of the contents. Burning gives these materials of the plant's structure back to the air, mainly in the same condition in which the plant took them, the same condition which is reached more slowly in natural decay. The chemical elements of the cell-walls (or cellulose, 402), as also of starch, sugar, and all that class of organizable cell-material, are carbon, hydrogen, and oxygen (399). The same, with nitrogen, are the constituents of protoplasm, or the truly vital part of vegetation.

449. These chemical elements out of which organic matters are composed are supplied to the plant by water, carbonic acid, and some combinations of nitrogen.

Water, far more largely than anything else, is imbibed by the roots; also more or less by the foliage in the form of vapor. Water consists of oxygen and hydrogen; and cellulose or plant-wall, starch, sugar, etc., however different in their qualities, agree in containing these two elements in the same relative proportions as in water.

Carbonic acid gas (Carbon dioxide) is one of the components of the atmosphere, — a small one, ordinarily only about $\frac{1}{2500}$ of its bulk, — sufficient for the supply of vegetation, but not enough to be injurious to animals, as it would be if accumulated. Every current or breeze of air brings to the leaves expanded in it a succession of fresh atoms of carbonic acid, which it absorbs through its multitudinous breathing-pores. This gas is also taken up by water. So it is brought to the ground by rain, and is absorbed by the roots of plants, either as dissolved in the water they imbibe, or in the form of gas in the interstices of the soil. Manured ground, that is, soil containing decomposing vegetable or animal matters, is constantly giving out this gas into the interstices of the soil, whence the roots of the growing crop absorb it. Carbonic acid thus supplied, primarily from the air, is the source of the carbon which forms much the largest part of the substance of every plant. The proportion of carbon may be roughly estimated by charring some wood or foliage; that is, by heating it out of contact with the air, so as to decompose and drive off all the other constituents of the fabric, leaving the large bulk of charcoal or carbon behind.

Nitrogen, the remaining plant-element, is a gas which makes up more than two thirds of the atmosphere, is brought into the foliage and also to the roots (being moderately soluble in water) in the same ways as is carbonic acid. The nitrogen which, mixed with oxygen, a little carbonic acid, and vapor of water, constitutes the air we breathe, is the source of this fourth plant-element. But it is very doubtful if ordinary plants can use any nitrogen gas directly as food; that is, if they can directly cause it to combine with the other elements so as to form protoplasm. But when combined with hydrogen (forming ammonia), or when combined with oxygen

(nitric acid and nitrates) plants appropriate it with avidity. And several natural processes are going on in which nitrogen of the air is so combined and supplied to the soil in forms directly available to the plant. The most efficient is *nitrification*, the formation of nitre (nitrate of potash) in the soil, especially in all fertile soils, through the action of a bacterial ferment.

450. Assimilation in plants is the conversion of these inorganic substances — essentially, water, carbonic acid, and some form of combined or combinable nitrogen — into vegetable matter. This most dilute food the living plant concentrates and assimilates to itself. Only plants are capable of converting these mineral into organizable matters; and this all-important work is done by them (so far as all ordinary vegetation is concerned) only

451. *Under the light of the sun, acting upon green parts or foliage*, that is, upon the chlorophyll, or upon what answers to chlorophyll, which these parts contain. The sun in some way supplies a power which enables the living plant to originate these peculiar chemical combinations, — to organize matter into forms which are alone capable of being endowed with life. The proof of this proposition is simple; and it shows at the same time, in the simplest way, what a plant does with the water and carbonic acid it consumes. Namely, 1st, it is only in sunshine or bright daylight that the green parts of plants give out oxygen gas, — then they regularly do so; and 2d, the giving out of this oxygen gas is required to render the chemical composition of water and carbonic acid the same as that of *cellulose*, that is, of the plant's permanent fabric. This shows why plants spread out so large a surface of foliage. Leaves are so many workshops, full of machinery worked by sun-power. The emission of oxygen gas from any sun-lit foliage is seen by placing some of this under water, or by using an aquatic plant, by collecting the air bubbles which rise, and by noting that a taper burns brighter in this air. Or a leafy plant in a glass globe may be supplied with a certain small percentage of carbonic acid gas, and after proper exposure to sunshine, the air on being tested will be found to contain less carbonic acid and just so much the more oxygen gas.

452. Now if the plant is making cellulose or any equivalent substance, — that is, is making the very materials of its fabric and growth, as must generally be the case, — all this oxygen gas given off by the leaves comes from the decomposition of carbonic acid taken in by the plant. For cellulose, and also starch, dextrine, sugar, and the like are composed of carbon along with oxygen and hydrogen in just the proportions to form water. And the carbonic acid and water taken in, less the oxygen which the carbon brought with it as carbonic acid, and which is given off from the foliage in sunshine, just represents the manufactured article, cellulose.

453. It comes to the same if the first product of assimilation is sugar, or dextrine which is a sort of soluble starch, or starch itself. And in the plant all these forms are readily changed into one another. In the tiny seedling, as fast as this assimilated matter is formed it is used in growth, that is, in the formation of cell-walls. After a time some or much of

the product may be accumulated in store for future growth, as in the root of the turnip, or the tuber of the potato, or the seed of corn or pulse. This store is mainly in the form of starch. When growth begins anew, this starch is turned into dextrine or into sugar, in liquid form, and used to nourish and build up the germinating embryo or the new shoot, where it is at length converted into cellulose and used to build up plant-structure.

454. But that which builds plant-fabric is not the cellular structure itself; the work is done by the living protoplasm which dwells within the walls. This also has to take and to assimilate its proper food, for its own maintenance and growth. Protoplasm assimilates, along with the other three elements, the nitrogen of the plant's food. This comes primarily from the vast stock in the atmosphere, but mainly through the earth, where it is accumulated through various processes in a fertile soil, — mainly, so far as concerns crops, from the decomposition of former vegetables and animals. This protoplasm, which is formed at the same time as the simpler cellulose, is essentially the same as the flesh of animals, and the source of it. It is the common basis of vegetable and of animal life.

455. *So plant-assimilation produces all the food and fabric of animals.* Starch, sugar, the oils (which are, as it were, these farinaceous matters more deoxidated), chlorophyll, and the like, and even cellulose itself, form the food of herbivorous animals and much of the food of man. When digested they enter into the blood, undergo various transformations, and are at length decomposed into carbonic acid and water, and exhaled from the lungs in respiration, — in other words, are given back to the air by the animal as the very same materials which the plant took from the air as its food, — are given back to the air in the same form that they would have taken if the vegetable matter had been left to decay where it grew, or if it had been set on fire and burned; and with the same result, too, as to the heat, — the heat in this case producing and maintaining the proper temperature of the animal.

456. The protoplasm and other products containing nitrogen (gluten, legumine, etc.), and which are most accumulated in grains and seeds (for the nourishment of their embryos when they germinate), compose the most nutritious vegetable food consumed by animals; they form their proper flesh and sinews, while the earthy constituents of the plant form the earthy matter of the bones, etc. At length decomposed, in the secretions and excretions, these nitrogenous constituents are through successive changes finally resolved into mineral matter, into carbonic acid, water, and ammonia or some nitrates, — into exactly or essentially the same materials which the plants took up and assimilated. Animals depend upon vegetables absolutely and directly for their subsistence; also indirectly, because

457. *Plants purify the air for animals.* In the very process by which they create food they take from the air carbonic acid gas, injurious to animal respiration, which is continually poured into it by the breathing of all animals, by all decay, by the burning of fuel and all other ordinary combustion; and

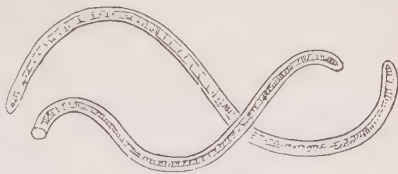
they restore an equal bulk of life-sustaining oxygen needful for the respiration of animals, — needful, also, in a certain measure, for plants in any work they do. For in plants, as well as in animals, work is done at a certain cost.

§ 6. PLANT WORK AND MOVEMENT.

458. As the organic basis and truly living material of plants is identical with that of animals, so is the life at bottom essentially the same; but in animals something is added at every rise from the lowest to highest organisms. Action and work in living beings require movement.

459. Living things move; those not living are only moved. Plants move as truly as do animals. The latter, nourished as they are upon organized food, which has been prepared for them by plants, and is found only here and there, must needs have the power of going after it, of collecting it, or at least of taking it in; which requires them to make spontaneous movements. But ordinary plants, with their wide-spread surface, always in contact with the earth and air on which they feed, — the latter everywhere the same, and the former very much so, — might be thought to have no need of movement. Ordinary plants, indeed, have no locomotion; some float, but most are rooted to the spot where they grew. Yet probably all of them execute various movements which must be as truly self-caused as are those of the lower grades of animals, — movements which are overlooked only because too slow to be directly observed. Nevertheless, the motion of the hour-hand and of the minute-hand of a watch is not less real than that of the second-hand.

460. Locomotion. Moreover, many microscopic plants living in water are seen to move freely, if not briskly, under the microscope; and so likewise do more conspicuous aquatic plants in their embryo-like or seedling state. Even at maturity, species of *Oscillaria* (such as in Fig. 488, minute worm-shaped plants of fresh waters, taking this name from their oscillating motions) freely execute three different kinds



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of movement, the very delicate investing coat of cellulose not impeding the action of the living protoplasm within. Even when this coat is firmer and hardened with a siliceous deposit, such crescent-shaped or boat-shaped one-celled plants as *Closterium* or *Navicula* are able in some way to move along from place to place in the water.

461. Movements in Cells, or Cell-circulation, sometimes called *Cyclosis*, has been detected in so many plants, especially in comparatively

FIG. 488. Two individuals of an *Oscillaria*, magnified.

transparent aquatic plants and in hairs on the surface of land plants (where it is easiest to observe), that it may be inferred to take place in all cells during the most active part of their life. This motion is commonly a



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a streaming movement of threads of protoplasm, carrying along solid granules by which the action may be observed and the rate measured, or in some cases it is a rotation of the whole protoplasmic contents of the cell. A comparatively low magnifying power will show it in the cells of *Nitella* and *Chara* (which are cryptogamous plants); and under a moderate power it is well seen in the Tape Grass of fresh water, *Vallisneria*, and in *Naias flexilis* (Fig. 489). Minute particles and larger greenish globules are seen to be carried along, as if in a current, around the cell, passing up one side, across the end, down the other and across the bottom, completing the circuit sometimes within a minute or less when well warmed. To see it well in the cell, which like a string of beads form the hairs on the stamens of *Spiderwort*, a high magnifying power is needed.

462. **Transference of Liquid from Cell to Cell,** and so from place to place in the plant, the absorption of water by the rootlets, and the exhalation of the greater part of it from the foliage,—these and similar operations are governed by the physical laws which regulate the diffusion of fluids, but are controlled by the action of living protoplasm. Equally under vital control are the various chemical transformations which attend assimilation and growth, and which involve not only molecular movements but conveyance. Growth itself, which is the formation and shaping of new parts, implies the direction of internal activities to definite ends.

463. **Movements of Organs.** The living protoplasm, in all but the lowest grade of plants, is enclosed and to common appearance isolated in separate cells, the walls of which can only in their earliest state be said to be alive. Still plants are able to cause the protoplasm of adjacent cells to act in concert, and by their combined action to effect movements in roots, stems, or leaves, some of them very slow and gradual, some manifest and striking. Such movements are brought about through individually minute changes in the form or tension in the protoplasm of the innumerable cells which make up the structure of the organ. Some of the slower movements are effected during growth, and may be explained by inequality of growth on the two sides of the bending organ. But the more rapid changes of position, and some of the slow ones, cannot be so explained.

FIG. 489. A few cells of a leaf of *Naias flexilis*, highly magnified: the arrows indicate the courses of the circulating currents.

464. **Root-movements.** In its growth a root turns or bends away from the light and toward the centre of the earth, so that in lengthening it buries itself in the soil where it is to live and act. Every one must have observed this in the germination of seeds. Careful observations have shown that the tip of a growing root also makes little sweeps or short movements from side to side. By this means it more readily insinuates itself into yielding portions of the soil. The root-tips will also turn toward moisture, and so secure the most favorable positions in the soil.

465. **Stem-movements.** The root end of the caulicle or first joint of stem (that below the cotyledons) acts like the root, in turning downward in germination (making a complete bend to do so if it happens to point upward as the seed lies in the ground), while the other end turns or points skyward. These opposite positions are taken in complete darkness as readily as in the light, in dryness as much as in moisture: there fore, so far as these movements are physical, the two portions of the same internode appear to be oppositely affected by gravitation or other influences.

466. Rising into the air, the stem and green shoots generally, while young and pliable, bend or direct themselves toward the light, or toward the stronger light when unequally illuminated; while roots turn toward the darkness.

467. Many growing stems have also a movement of *Nutation*, that is, of nodding successively in different directions. This is brought about by a temporary increase of turgidity of the cells along one side, thus bowing the stem over to the opposite side; and this line of turgescence travels round the shoot continually, from right to left or from left to right according to the species: thus the shoot bends to all points of the compass in succession. Commonly this nutation is slight or hardly observable. It is most marked in

468. **Twining Stems** (Fig. 90). The growing upper end of such stems, as is familiar in the Hop, Pole Beans, and Morning-Glory, turns over in an inclined or horizontal direction, thus stretching out to reach a neighboring support, and by the continual change in the direction of the nodding, sweeps the whole circle, the sweeps being the longer as the stem lengthens. When it strikes against a support, such as a stem or branch of a neighboring plant, the motion is arrested at the contact, but continues at the growing apex beyond, and this apex is thus made to wind spirally around the supporting body.

469. **Leaf-movements** are all but universal. The presentation by most leaves of their upper surface to the light, from whatever direction that may come, is an instance; for when turned upside down they twist or bend round on the stalk to recover this normal position. Leaves, and the leaflets of compound leaves, change this position at nightfall, or when the light is withdrawn; they then take what is called their sleeping posture, resuming the diurnal position when daylight returns. This is very striking

in Locust-trees, in the Sensitive Plant (Fig. 490), and in Woodsorrel. Young seedlings droop or close their leaves at night in plants which are not thus affected in the adult foliage. All this is thought to be a protection against the cold by nocturnal radiation.

470. Various plants climb by a coiling movement of their leaves or their leaf-stalks. Familiar examples are seen in *Clematis*, *Maurandia*, *Tropæolum*, and in a *Solanum* which is much cultivated in greenhouses (Fig. 172). In the latter, and in other woody plants which climb in this way, the petioles thicken and harden after they have grasped their support, thus securing a very firm hold.

471. **Tendrils.** Tendrils are either leaves or stems (98, 165), specially developed for climbing purposes. *Cobæa* is a good example of partial transformation; some of the leaflets are normal, some of the same leaf are little tendrils, and some intermediate in character. The Passion-flowers give good examples of simple stem-tendrils (Fig. 92); Grape-Vines, of branched ones. Most tendrils make revolving sweeps, like those of twining stems. Those of some Passion-flowers, in sultry weather, are apt to move fast enough for the movement actually to be seen for a part of the circuit, as plainly as that of the second-hand of a watch. Two herbaceous species, *Passiflora gracilis* and *P. sicyoides* (the first an annual, the second a strong-rooted perennial of the easiest cultivation), are admirable for illustration both of revolving movements and of sensitive coiling.

472. **Movements under Irritation.** The most familiar case is that of the Sensitive Plant (Fig. 490). The leaves suddenly take their nocturnal position when roughly touched or when shocked by a jar. The leaflets close in pairs, the four outspread partial petioles come closer together, and the common petiole is depressed.

The seat of the movements is at the base of the leaf-stalk and stalklets. *Schrankia*, a near relative of the Sensitive Plant, acts in the same way, but is slower. These are not anomalous actions, but only

extreme manifestations of a faculty more or less common in foliage. In Locust and Honey-Locusts for example, repeated jars will slowly produce similar effects.

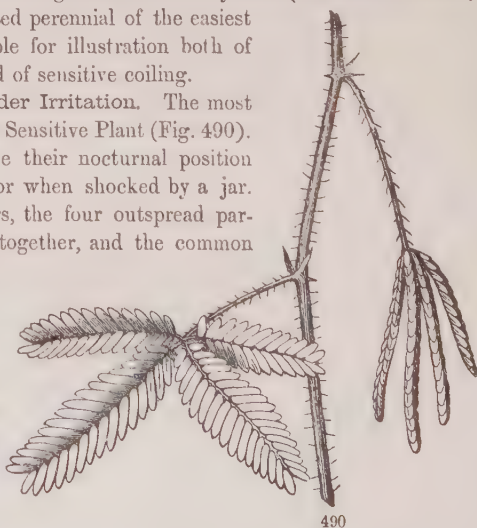


FIG. 490. Piece of stem of Sensitive Plant (*Mimosa pudica*), with two leaves, the lower open, the upper in the closed state.

473. Leaf-stalks and tendrils are adapted to their uses in climbing by a similar sensitiveness. The coiling of the leaf-stalk is in response to a kind of irritation produced by contact with the supporting body. This may be shown by gentle rubbing or prolonged pressure upon the upper face of the leaf-stalk, which is soon followed by a curvature. Tendrils are still more sensitive to contact or light friction. This causes the free end of the tendril to coil round the support, and the sensitiveness, propagated downward along the tendril, causes that side of it to become less turgescient or the opposite side more so, thus throwing the tendril into coils. This shortening draws the plant up to the support. Tendrils which have not laid hold will at length commonly coil spontaneously, in a simple coil, from the free apex downward. In *Sicyos*, *Echinocystis*, and the above mentioned Passion-flowers (471), the tendril is so sensitive, under a high summer temperature, that it will curve and coil promptly after one or two light strokes by the hand.

474. Among spontaneous movements the most singular are those of *Desmodium gyrans* of India, sometimes called Telegraph-plant, which is cultivated on account of this action. Of its three leaflets, the larger (terminal) one moves only by drooping at nightfall and rising with the dawn. But its two small lateral leaflets, when in a congenial high temperature, by day and by night move upward and downward in a succession of jerks, stopping occasionally, as if to recover from exhaustion. In most plant-movements some obviously useful purpose is subserved: this of *Desmodium gyrans* is a riddle.

475. **Movements in Flowers** are very various. The most remarkable are in some way connected with fertilization (Sect. XIII.). Some occur under irritation: the stamens of Barberry start forward when touched at the base inside: those of many polyandrous flowers (of *Sparmannia* very strikingly) spread outwardly when lightly brushed: the two lips or lobes



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FIG. 491. Portion of stem and leaves of Telegraph-plant (*Desmodium gyrans*), almost of natural size.

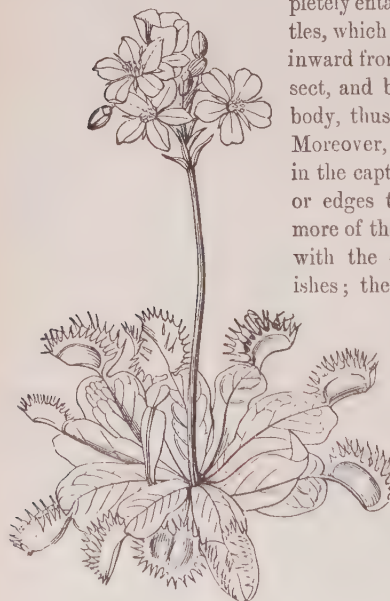
of the stigma in *Mimulus* close after a touch. Some are automatic and are connected with dichogamy (339): the style of *Sabbatia* and of large-flowered species of *Epilobium* bends over strongly to one side or turns downward when the blossom opens, but slowly erects itself a day or two later.

476. **Extraordinary Movements connected with Capture of Insects.** The most striking cases are those of *Drosera* and *Dionæa*; for an account of which see "How Plants Behave," and Goodale's "Physiological Botany."

477. The upper face of the leaves of the common species of *Drosera*, or Sundew, is beset with stout bristles, having a glandular tip. This tip secretes a drop of a clear but very viscid liquid, which glistens like a dew-drop in the sun; whence the popular name. When a fly or other small insect, attracted by the liquid, alights upon the leaf, the viscid drops are so tenacious that they hold it fast. In struggling it only becomes more completely entangled. Now the neighboring bristles, which have not been touched, slowly bend inward from all sides toward the captured insect, and bring their sticky apex against its body, thus increasing the number of bonds. Moreover, the blade of the leaf commonly aids in the capture by becoming concave, its sides or edges turning inward, which brings still more of the gland-tipped bristles into contact with the captive's body. The insect perishes; the clear liquid disappears, apparently

by absorption into the tissue of the leaf. It is thought that the absorbed secretion takes with it some of the juices of the insect or the products of its decomposition.

478. *Dionæa muscipula*, the most remarkable vegetable fly-trap (Fig. 176, 492), is related to the Sundews, and has a more special and active apparatus for fly-catching, formed of the summit



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of the leaf. The two halves of this rounded body move as if they were hinged upon the midrib; their edges are fringed with spiny but not glandular bristles, which interlock when the organ closes. Upon the face are two or three short and delicate bristles, which are sensitive. They do not themselves move when touched, but they propagate the sensitiveness to the organ itself, causing it to close with a quick movement. In a fresh

and vigorous leaf, under a high summer temperature, and when the trap lies widely open, a touch of any one of the minute bristles on the face, by the finger or any extraneous body, springs the trap (so to say), and it closes suddenly; but after an hour or so it opens again. When a fly or other small insect alights on the trap, it closes in the same manner, and so quickly that the intercrossing marginal bristles obstruct the egress of the insect, unless it be a small one and not worth taking. Afterwards and more slowly it completely closes, and presses down upon the prey; then some hidden glands pour out a gummy liquid, which dissolves out the juices of the insect's body; next all is re-absorbed into the plant, and the trap opens to repeat the operation. But the same leaf perhaps never captures more than two or three insects. It ages instead, becomes more rigid and motionless, or decays away.

479. That some few plants should thus take animal food will appear less surprising when it is considered that hosts of plants of the lower grade, known as Fungi, moulds, rusts, ferments, Bacteria, etc., live upon animal or other organized matter, either decaying or living. That plants should execute movements in order to accomplish the ends of their existence is less surprising now when it is known that the living substance of plants and animals is essentially the same; that the beings of both kingdoms partake of a common life, to which, as they rise in the scale, other and higher endowments are successively superadded.

480. Work uses up material and energy in plants as well as in animals. The latter live and work by the consumption and decomposition of that which plants have assimilated into organizable matter through an energy derived from the sun, and which is, so to say, stored up in the assimilated products. In every internal action, as well as in every movement and exertion, some portion of this assimilated matter is transformed and of its stored energy expended. The steam-engine is an organism for converting the sun's radiant energy, stored up by plants in the fuel, into mechanical work. An animal is an engine fed by vegetable fuel in the same or other forms, from the same source, by the decomposition of which it also does mechanical work. The plant is the producer of food and accumulator of solar energy or force. But the plant, like the animal, is a consumer whenever and by so much as it does any work except its great work of assimilation. Every internal change and movement, every transformation, such as that of starch into sugar and of sugar into cell-walls, as well as every movement of parts which becomes externally visible, is done at the expense of a certain amount of its assimilated matter and of its stored energy; that is, by the decomposition or combustion of sugar or some such product into carbonic acid and water, which is given back to the air, just as in the animal it is given back to the air in respiration. So the respiration of plants is as real and as essential as that of animals. But what plants consume or decompose in their life and action is of insignificant amount in comparison with what they compose.

SECTION XVII. CRYPTOGRAMOUS OR FLOWERLESS PLANTS.

481. Even the beginner in botany should have some general idea of what cryptogamous plants are, and what are the obvious distinctions of the principal families. Although the lower grades are difficult, and need special books and good microscopes for their study, the higher orders, such as Ferns, may be determined almost as readily as phanerogamous plants.

482. Linnæus gave to this lower grade of plants the name of *Cryptogamia*, thereby indicating that their organs answering to stamens and pistils, if they had any, were recondite and unknown. There is no valid reason why this long-familiar name should not be kept up, along with the counterpart one of *Phanerogamia* (6), although organs analogous to stamens and pistil, or rather to pollen and ovule, have been discovered in all the higher and most of the lower grades of this series of plants. So also the English synonymous name of *Flowerless Plants* is both good and convenient: for they have not flowers in the proper sense. The essentials of flowers are stamens and pistils, giving rise to seeds, and the essential of a seed is an embryo (8). Cryptogamous or Flowerless plants are propagated by SPORES; and a spore is not an embryo-plantlet, but mostly a single plant-cell (399).

483. Vascular Cryptogams, which compose the higher orders of this series of plants, have stems and (usually) leaves, constructed upon the general plan of ordinary plants; that is, they have wood (wood-cells and vessels, 408) in the stem and leaves, in the latter as a frame work of veins. But the lower grades, having only the more elementary cellular structure, are called *Cellular Cryptogams*. Far the larger number of the former are Ferns: wherefore that class has been called

484. Pteridophyta, Pteridophytes in English form, meaning *Fern-plants*,—that is, Ferns and their relatives. They are mainly Horsetails, Ferns, Club-Mosses, and various aquatics which have been called *Hydropterides*, i. e. Water-Ferns.

485. Horsetails, *Equisetaceæ*, is the name of a family which consists only (among now-living plants) of *Equisetum*, the botanical name of Horsetail and Scouring Rush. They have hollow stems, with partitions at the nodes; the leaves consist only of a whorl of scales at each node, these coalescent into a sheath: from the axils of these leaf-scales, in many species, branches grow out, which are similar to the stem but on a much smaller scale, close-jointed, and with the tips of the leaves more apparent. At the apex of the stem appears the *fructification*, as it is called for lack of a better term, in the form of a short spike or head. This consists of a good number of stalked shields, bearing on their inner or under face several wedge-shaped spore-cases. The spore-cases when they ripen open down the inner

side and discharge a great number of green spores of a size large enough to be well seen by a hand-glass. The spores are aided in their discharge



and dissemination by four club-shaped threads attached to one part of them. These are hygrometric: when moist they are rolled up over the spore; when dry they straighten, and exhibit lively movements, closing over the spore when breathed upon, and unrolling promptly a moment after as they dry. (See Fig. 493–498.)

486. **Ferns, or Filices**, a most attractive family of plants, are very numerous and varied. In warm and equable climates some rise into forest-trees, with habit of Palms; but most of them are perennial herbs. The wood of a Fern-trunk is very different, however, from that of a palm, or of any exogenous stem either. A section is represented in Fig. 500. The curved plates of wood each ter-

FIG. 493. Upper part of a stem of a Horsetail, *Equisetum sylvaticum*. 494. Part of the head or spike of spore-cases, with some of the latter taken off. 495. View (more enlarged) of under side of the shield-shaped body, bearing a circle of spore-cases. 496. One of the latter detached and more magnified. 497. A spore with the attached arms moistened. 498. Same when dry, the arms extended.

FIG. 499. A Tree-Fern, *Dicksonia arborescens*, with a young one near its base. In front a common herbaceous Fern (*Polypodium vulgare*) with its creeping stem or rootstock.

FIG. 500. A section of the trunk of a Tree-Fern.

minate upward in a leaf-stalk. The subterranean trunk or stem of any strong-growing herbaceous Fern shows a similar structure. Most Ferns are circinate in the bud; that is, are rolled up in the manner shown in Fig. 197. Uncoiling as they grow, they have some likeness to a crosier.

487. The fructification of Ferns is borne on the back or under side of the leaf. The early botanists thought this such a peculiarity that they



always called a Fern-leaf a **FROND**, and its petiole a **STIPE**. Usage continues these terms, although they are superfluous. The fruit of Ferns consists of **SPORE-CASES**, technically **SPORANGIA**, which grow out of the veins of the leaf. Sometimes these are distributed over the whole lower

FIG. 501. The Walking-Fern, *Camptosorus*, reduced in size, showing its fruit-dots on the veins approximated in pairs. 502. A small piece (pinnule) of a Shield-Fern: a row of fruit-dots on each side of the midrib, each covered by its kidney-shaped indusium. 503. A spore-case from the latter, just bursting by the partial straightening of the incomplete ring; well magnified. 504. Three of the spores of 503, more magnified. 505. *Schizaea pusilla*, a very small and simple-leaved Fern, drawn nearly of natural size. 506. One of the lobes of its fruit-bearing portion, magnified, bearing two rows of spore-cases. 507. Spore-case of the latter, detached, opening lengthwise. 508. Adder-tongue, *Ophioglossum*: spore-cases in a kind of spike: *a*, a portion of the fruiting part, about natural size; showing two rows of the firm spore-cases, which open transversely into two valves.

surface of the leaf or frond, or over the whole surface when there are no proper leaf-blades to the frond, but all is reduced to stalks. Commonly the spore-cases occupy only detached spots or lines, each of which is called a *SORUS*, or in English merely a Fruit-dot. In many Ferns these fruit-dots are naked; in others they are produced under a scale-like bit of membrane, called an *INDUSIUM*. In Maidenhair-Ferns a little lobe of the leaf is folded back over each fruit-dot, to serve as its shield or indusium. In the true Brake or Bracken (*Pteris*) the whole edge of the fruit-bearing part of the leaf is folded back over it like a hem.

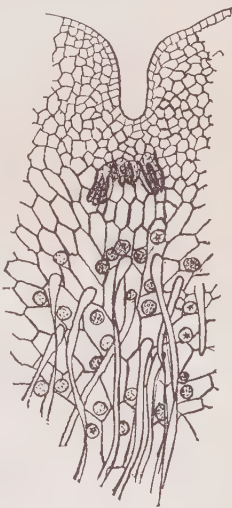
488. The form and structure of the spore-cases can be made out with a common hand magnifying glass. The commonest kind (shown in Fig. 503) has a stalk formed of a row of jointed cells, and is itself composed of a layer of thin-walled cells, but is incompletely surrounded by a border of thicker-walled cells, forming the *RING*. This extends from the stalk up one side of the spore-case, round its summit, descends on the other side, but there gradually vanishes. In ripening and drying the shrinking of the cells of the ring on the outer side causes it to straighten; in doing so it tears the spore-case open on the weaker side and discharges the minute spores that fill it, commonly with a jerk which scatters them to the wind. Another kind of spore-case (Fig. 507)

is stalkless, and has its ring-cells forming a kind of cap at the top: at maturity it splits from top to bottom by a regular dehiscence. A third kind is of firm texture and opens across into two valves, like a clam-shell (Fig. 508^a): this kind makes an approach to the next family.

489. The spores germinate on moistened ground. In a conservatory they may be found germinating



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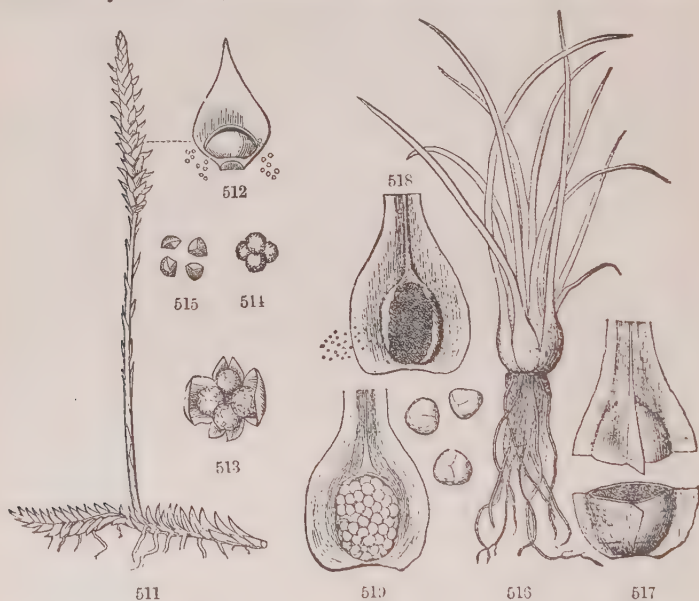
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on a damp wall or on the edges of a well-watered flower-pot. Instead of directly forming a fern-plantlet, the spore grows first into a body which

FIG. 509. A young prothallus of a Maiden-hair, moderately enlarged, and an older one with the first fern-leaf developed from near the notch. 510. Middle portion of the young one, much magnified, showing below, partly among the rootlets, the *antheridia* or fertilizing organs, and above, near the notch, three *pistillidia* to be fertilized.

closely resembles a small Liverwort. This is named a PROTHALLUS (Fig. 509) : from some point of this a bud appears to originate, which produces the first fern-leaf, soon followed by a second and third, and so the stem and leaves of the plant are set up.

490. Investigation of this prothallus under the microscope resulted in the discovery of a wholly unsuspected kind of fertilization, taking place at



this germinating stage of the plant. On the under side of the prothallus two kinds of organs appear (Fig. 510). One may be likened to an open and depressed ovule, with a single cell at bottom answering to nucleus ; the other, to an anther ; but instead of pollen, it discharges corkscrew-shaped microscopic filaments, which bear some cilia of extreme tenuity, by the rapid vibration of which the filaments move freely over a wet surface. These filaments travel over the surface of the prothallus, and even to other prothalli (for there are natural hybrid Ferns), reach and enter the ovule-

FIG. 511. *Lycopodium Carolinianum*, of nearly natural size. 512. Inside view of one of the bracts and spore-case, magnified.

FIG. 513. Open 4-valved spore-case of a *Selaginella*, and its four large spores (macrospores), magnified. 514. Macrospores of another *Selaginella*. 515. Same separated.

FIG. 516. Plant of *Isoetes*. 517. Base of a leaf and contained sporocarp filled with microspores cut across, magnified. 518. Same divided lengthwise, equally magnified ; some microspores seen at the left. 519. Section of a spore-case containing macrospores, equally magnified ; at the right three macrospores more magnified.

like cavities, and fertilize the cell. This thereupon sets up a growth, forms a vegetable bud, and so develops the new plant.

491. An essentially similar process of fertilization has been discovered in the preceding and the following families of Pteridophytes; but it is mostly subterranean and very difficult to observe.

492. **Club-Mosses or Lycopodiums.** Some of the common kinds, called Ground Pine, are familiar, being largely used for Christmas wreaths and other decoration. They are low evergreens, some creeping, all with considerable wood in their stems: this thickly beset with small leaves. In the axils of some of these leaves, or more commonly, in the axils of peculiar leaves changed into bracts (as in Fig. 511, 512) spore-cases appear, as roundish or kidney-shaped bodies, of firm texture, opening round the top into two valves, and discharging a great quantity of a very fine yellow powder, the spores.

493. The Selaginellas have been separated from Lycopodium, which they much resemble, because they produce two kinds of spores, in separate spore-cases. One kind (MICROSPORES) is just that of Lycopodium; the other consists of only four large spores (MACRO-SPORES), in a spore-case which usually breaks in pieces at maturity (Fig. 513-515).

494. **The Quillworts, Isoetes** (Fig. 516-519), are very unlike Club Mosses in aspect, but have been associated with them. They look more like Rushes, and live in water, or partly out of it. A very short stem, like a corm, bears a cluster of roots underneath; above it is covered by the broad bases of a cluster of awl-shaped or thread-shaped leaves. The spore-cases are immersed in the bases of the leaves. The outer leaf-bases contain numerous macrospores; the inner are filled with innumerable microspores.

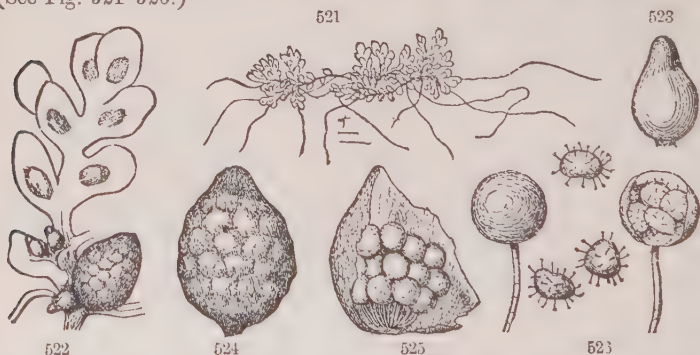
495. **The Pillworts** (*Marsilia* and *Pilularia*) are low aquatics, which



FIG. 520. Plant of *Marsilia quadrifoliata*, reduced in size; at the right a pair of spore-caps of about natural size.

bear globular or pill-shaped fruit (SPOROCARPS) on the lower part of their leaf-stalks or on their slender creeping stems. The leaves of the commoner species of *Marsilia* might be taken for four-leaved Clover. (See Fig. 520.) The sporocarps are usually raised on a short stalk. Within they are divided lengthwise by a partition, and then crosswise by several partitions. These partitions bear numerous delicate sacs or spore-cases of two kinds, intermixed. The larger ones contain each a large spore, or macrospore; the smaller contain numerous microspores, immersed in mucilage. At maturity the fruit bursts or splits open at top, and the two kinds of spores are discharged. The large ones in germination produce a small prothallus; upon which the contents of the microspores act in the same way as in Ferns, and with a similar result.

496. *Azolla* is a little floating plant, looking like a small Liverwort or Moss. Its branches are covered with minute and scale-shaped leaves. On the under side of the branches are found egg-shaped thin-walled sporocarps of two kinds. The small ones open across and discharge microspores; the larger burst irregularly, and bring to view globose spore-cases, attached to the bottom of the sporocarp by a slender stalk. These delicate spore-cases burst and set free about four macrospores, which are fertilized at germination, in the manner of the Pillworts and Quillworts. (See Fig. 521-526.)



497. Cellular Cryptogams (483) are so called because composed, even in their higher forms, of cellular tissue only, without proper wood-cells or vessels. Many of the lower kinds are mere plates, or ribbons, or simple rows of cells, or even single cells. But their highest orders follow the plan of Ferns and phanerogamous plants in having stem and leaves for their upward growth, and commonly roots, or at least rootlets,

FIG. 521. Small plant of *Azolla Caroliniana*. 522. Portion magnified, showing the two kinds of sporocarp: the small ones contain microspores; 523 represents one more magnified. 524. The larger sporocarp more magnified. 525. Same more magnified and burst open, showing stalked spore-cases. 526. Two of the latter highly magnified; one of them bursting shows four contained macrospores: between the two, three of these spores highly magnified.

to attach them to the soil, or to trunks, or to other bodies on which they grow. Plants of this grade are chiefly Mosses. So as a whole they take the name of

498. *Bryophyta*, *Bryophytes* in English form, *Bryum* being the Greek name of a Moss. These plants are of two principal kinds: true Mosses (*Musci*, which is their Latin name in the plural); and Hepatic Mosses, or Liverworts (*Hepaticæ*).

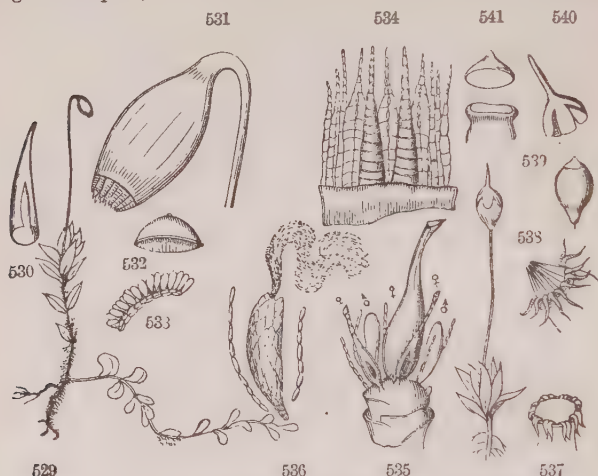
499. **Mosses or Musci.** The pale Peat-mosses (species of *Sphagnum*, the principal component of sphagnum bogs) and the strong-growing Hair-cap Moss (*Polytrichum*) are among the larger and commoner representatives of this numerous family; while Fountain Moss (*Fountainalis*) in running water sometimes attains the length of a yard or more. On the other hand, some are barely individually distinguishable to the naked eye. Fig. 527 represents a common little Moss, enlarged to about twelve times its natural size; and by its side is part of a leaf, much magnified, showing that it is composed of cellular tissue (parenchyma-cells) only. The leaves of Mosses are always simple, distinct, and sessile on the stem. The fructification is an urn-shaped spore-case, in this as in most cases raised on a slender stalk. The spore-case loosely bears on its summit a thin and pointed cap, like a candle-extinguisher, called a *Calyptra*. Detaching this, it is found that the spore-case is like a pyxis (376), that is, the top at maturity comes off as a lid (*Operculum*); and that the interior is filled with a green powder, the spores, which are discharged through the open mouth. In most Mosses there is a fringe of one or two rows of teeth or membrane around this mouth or orifice, the *Peristome*. When moist the peristome closes hygro-metrically over the orifice more or less; when drier the teeth or processes commonly bend outward or recurve; and then the spores more readily escape. In Hair-cap Moss a membrane is stretched quite across the mouth, like a drum-head, retaining the spores until this wears away. See Figures 527-541 for details.

500. Fertilization in Mosses is by the analogues of stamens and pistils, which are hidden in the axils of leaves, or in the cluster of leaves at the



FIG. 527. Single plant of *Physcomitrium pyriforme*, magnified. 528. Top of a leaf, cut across; it consists of a single layer of cells.

end of the stem. The analogue of the anther (*Antheridium*) is a cellular sac, which in bursting discharges innumerable delicate cells floating in a mucilaginous liquid; each of these bursts and sets free a vibratile self-



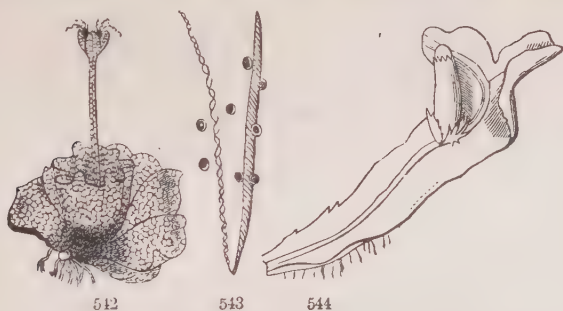
moving thread. These threads, one or more, reach the orifice of the pistil-shaped body, the *Pistillidium*, and act upon a particular cell at its base within. This cell in its growth develops into the spore-case and its stalk (when there is any), carrying on its summit the wall of the pistillidium, which becomes the calyptra.

501. Liverworts or Hepatic Mosses (*Hepaticæ*) in some kinds resemble true Mosses, having distinct stem and leaves, although their leaves occasionally run together; while in others there is no distinction of stem and leaf, but the whole plant is a leaf-like body, which produces rootlets on the lower face and its fructification on the upper. Those of the moss-like kind (sometimes called Scale-Mosses) have their tender spore-cases splitting into four valves; and with their spores are intermixed some slender spiral

FIG. 529. *Mnium cuspidatum*, smaller than nature. 530. Its calyptra, detached, enlarged. 531. Its spore-case, with top of stalk, magnified, the lid (532) being detached, the outer peristome appears. 533. Part of a cellular ring (*annulus*) which was under the lid, outside of the peristome, more magnified. 534. Some of the outer and of the inner peristome (consisting of jointed teeth) much magnified. 535. Antheridia and a pistillidium (the so-called flower) at end of a stem of same plant, the leaves torn away (♂, antheridia, ♀, pistillidium), magnified. 536. A bursting antheridium, and some of the accompanying jointed threads, highly magnified. 537. Summit of an open spore-case of a Moss, which has a peristome of 16 pairs of teeth. 538. The double peristome of a *Hypnum*. 539-541. Spore-case, detached calyptra, and top of more enlarged spore-case and detached lid, of *Physcomitrium pyriforme* (Fig. 527): orifice shows that there is no peristome.

and very hygrometric threads (called *Elaters*) which are thought to aid in the dispersion of the spores. (Fig. 542-544.)

502. *Marchantia*, the commonest and largest of the true Liverworts, forms large green plates or fronds on damp and shady ground, and sends up from some part of the upper face a stout stalk, ending in a several-lobed umbrella-shaped body, under the lobes of which hang several thin-walled spore-cases, which burst open and discharge spores and elaters. *Riccia natans* (Fig. 545) consists of wedge-shaped or heart-shaped fronds, which float free in pools of still water. The under face bears copious rootlets; in the substance of the upper face are the spore-cases, their pointed tips



merely projecting: there they burst open, and discharge their spores. These are comparatively few and large, and are in fours; so they are very like the macrospores of Pillworts or Quillworts.

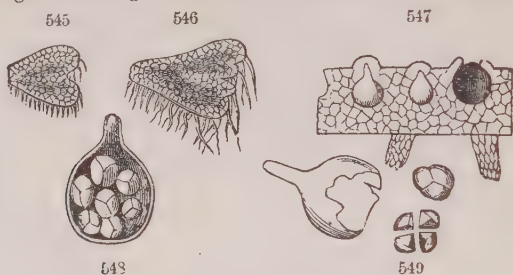
503. **Thallophyta**, or **Thallophytes** in English form. This is the name for the lower class of Cellular Cryptogams, — plants in which there is no marked distinction into root, stem, and leaves. Roots in any proper sense they never have, as organs for absorbing, although some of the larger Seaweeds (such as the Sea Colander, Fig. 553) have them as holdfasts. Instead of axis and foliage, there is a stratum of frond, in such plants commonly called a **THALLUS** (by a strained use of a Greek and Latin word which means a green shoot or bough), which may have any kind of form, leaf-like, stem-like, branchy, extended to a flat plate, or gathered into a sphere, or drawn out into threads, or reduced to a single row of cells, or even reduced to single cells. Indeed, Thallophytes are so multifarious, so numerous in kinds, so protean in their stages and transformations, so recondite in their fructification, and many so microscopic in size, either of

FIG. 542. Fructification of a *Jungermannia*, magnified; its cellular spore-stalk, surrounded at base by some of the leaves, at summit the 4 valved spore-case opening, discharging spores and elaters. 543. Two elaters and some spores from the same, highly magnified.

FIG. 544. One of the frondose Liverworts, *Steetzia*, otherwise like a *Jungermannia*; the spore-case not yet protruded from its sheath.

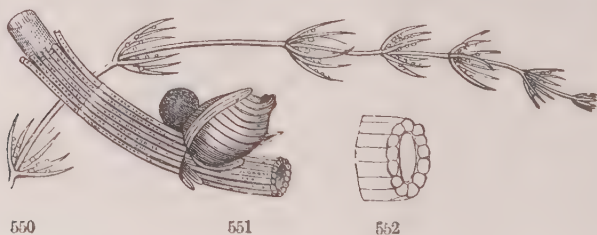
the plant itself or its essential organs, that they have to be elaborately described in separate books and made subjects of special study.

504. Nevertheless, it may be well to try to give some general idea of what Algæ and Lichens and Fungi are. Linnæus had them all under the orders of Algæ and Fungi. Afterwards the Lichens were separated; but



of late it has been made most probable that a Lichen consists of an Alga and a Fungus conjoined. At least it must be so in some of the ambiguous forms. Botanists are in the way of bringing out new classifications of the Thallophtes, as they come to understand their structure and relations better. Here, it need only be said that

505. Lichens live in the air, that is, on the ground, or on rocks, trunks, walls, and the like, and grow when moistened by rains. They assimilate air, water, and some earthy matter, just as do ordinary plants. Algæ, or Sea-



weeds, live in water, and live the same kind of life as do ordinary plants. Fungi, whatever medium they inhabit, live as animals do, upon organic matter, — upon what other plants have assimilated, or upon the products of

FIG. 545, 546. Two plants of *Riccia natans*, about natural size. 547. Magnified section of a part of the frond, showing two immersed spore-cases, and one emptied space. 548. Magnified section of a spore-case with some spores. 549. Magnified spore-case torn out, and spores; one figure of the spores united; the other of the four separated.

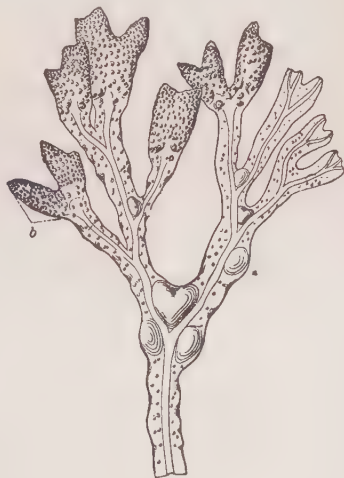
FIG. 550. Branch of a *Chara*, about natural size. 551. A fruiting portion, magnified, showing the structure; a sporocarp, and an antheridium. 552. Outlines of a portion of the stem in section, showing the central cell and the outer or cortical cells.

their decay. True as these general distinctions are, it is no less true that these orders run together in their lowest forms; and that Algæ and Fungi may be traced down into forms so low and simple that no clear line can be drawn between them; and even into forms of which it is uncertain whether they should be called plants or animals. It is as well to say that they are not high enough in rank to be distinctively either the one or the other. On the other hand there is a peculiar group of plants, which in simplicity of composition resemble the simpler Algæ, while in fructification and in the arrangements of their simple cells into stem and branches they seem to be of a higher order, viz. : —

506. *Characeæ*. These are aquatic herbs, of considerable size, abounding in ponds. The simpler kinds (*Nitella*) have the stem formed of a single row of tubular cells, and at the nodes, or junction of the cells, a whorl of similar branches. *Chara* (Fig. 550–552) is the same, except that the cells which make up the stem and the principal branches are strengthened by a coating of many smaller tubular cells, applied to the surface of the main or central cell. The fructification consists of a globular sporocarp of considerable size, which is spirally



553



554

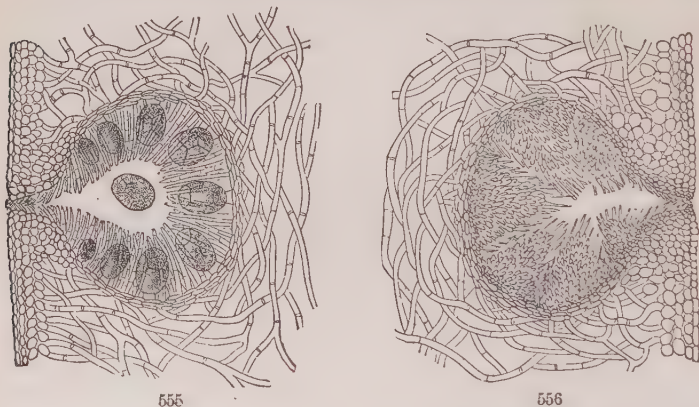
enwrapped by tubular cells twisted around it: by the side of this is a smaller and globular antheridium. The latter breaks up into eight shield-

FIG. 553. *Agarum Turneri*, Sea Colander (so called from the perforations with which the frond, as it grows, becomes riddled); very much reduced in size.

FIG. 554. Upper end of a Rockweed, *Fucus vesiculosus*, reduced half or more, *b*, the fructification.

shaped pieces, with an internal stalk, and bearing long and ribbon shaped filaments, which consist of a row of delicate cells, each of which discharges a free-moving microscopic thread (the analogue of the pollen or pollen-tube), nearly in the manner of Ferns and Mosses. One of these threads reaches and fertilizes a cell at the apex of the nucleus or solid body of the sporocarp. This subsequently germinates and forms a new individual.

507. *Algæ* or *Seaweeds*. The proper *Seaweeds* may be studied by the aid of Professor Farlow's "*Marine Algæ of New England*;" the



fresh-water species, by Prof. H. C. Woods's "*Fresh-water Algæ of North America*," a larger and less accessible volume. A few common forms are here very briefly mentioned and illustrated, to give an idea of the family. But they are of almost endless diversity.

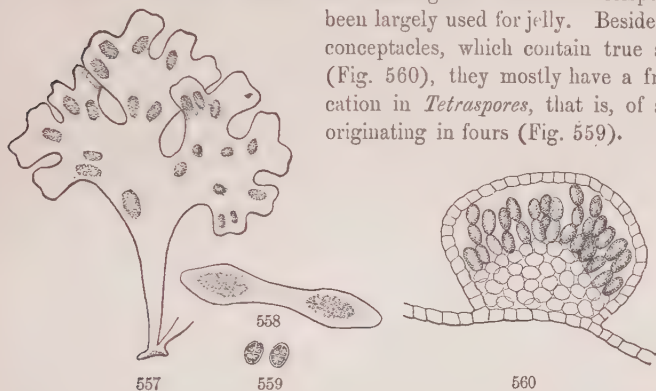
508. The common *Rockweed* (*Fucus vesiculosus*, Fig. 554, abounding between high and low water mark on the coast), the rarer *Sea Colander* (*Agarum Turneri*, Fig. 553), and *Laminaria*, of which the larger forms are called *Devil's Aprons*, are good representatives of the olive green or brownish *Seaweeds*. They are attached either by a disk-like base or by root-like holdfasts to the rocks or stones on which they grow.

509. The hollow and inflated places in the *Fucus vesiculosus* or *Rockweed* (Fig. 554) are air-bladders for buoyancy. The fructification forms in the substance of the tips of the frond: the rough dots mark the places where the conceptacles open. The spores and the fertilizing cells are in different plants. Sections of the two kinds of conceptacles are given in Fig. 555 and 556. The contents of the conceptacles are discharged through

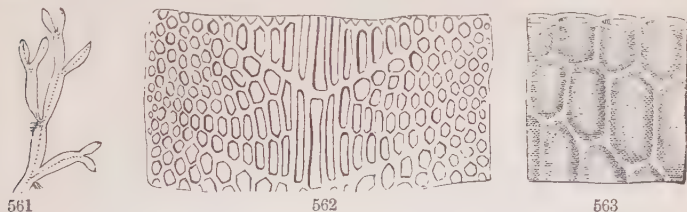
FIG. 555. Magnified section through a fertile conceptacle of *Rockweed*, showing the large spores in the midst of threads of cells. 556. Similar section of a sterile conceptacle, containing slender antheridia. From Farlow's "*Marine Algæ of New England*."

a small orifice which in each figure is at the margin of the page. The large spores are formed eight together in a mother-cell. The minute motile filaments of the antheridia fertilize the large spores after injection into the water: and then the latter promptly acquire a cell-wall and germinate.

510. The Florideæ or Rose-red series of marine Algæ (which, however, are sometimes green or brownish) are the most attractive to amateurs. The delicate *Porphyra* or Laver is in some countries eaten as a delicacy, and the cartilaginous *Chondrus crispus* has been largely used for jelly. Besides their conceptacles, which contain true spores (Fig. 560), they mostly have a fructification in *Tetraspores*, that is, of spores originating in fours (Fig. 559).



511. The Grass-green Algæ sometimes form broad membranous fronds, such as those of the common *Ulva* of the sea-shore, but most of them form



mere threads, either simple or branched. To this division belong almost

FIG. 557. Small plant of *Chondrus crispus*, or Carrageen Moss, reduced in size, in fruit; the spots represent the fructification, consisting of numerous tetraspores in bunches in the substance of the plant. 558. Section through the thickness of one of the lobes, magnified, passing through two of the imbedded fruit-clusters. 559. Two of its tetraspores (spores in fours), highly magnified.

FIG. 560. Section through a conceptacle of *Delesseria Leprieurei*, much magnified, showing the spores, which are single specialized cells, two or three in a row.

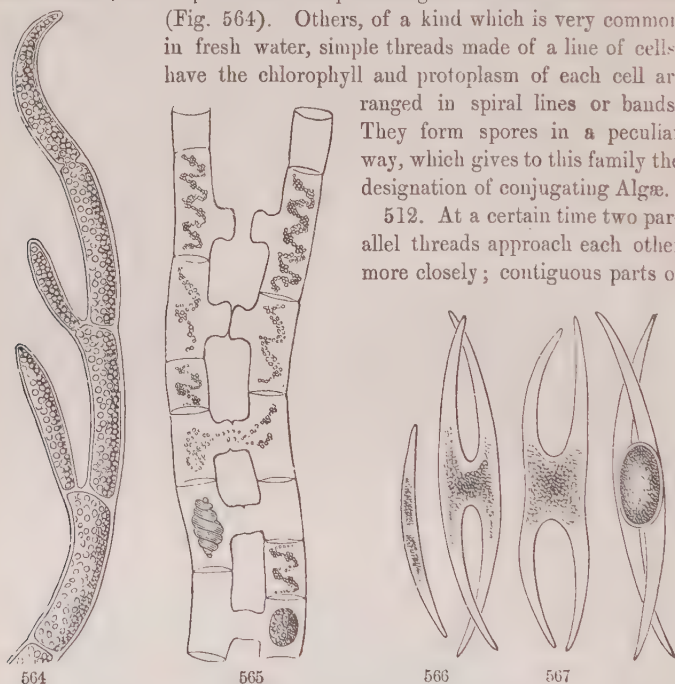
FIG. 561. A piece of the rose-red *Delesseria Leprieurei*, double natural size. 562. A piece cut out and much magnified, showing that it is composed of a layer of cells. 563. A few of the cells more highly magnified: the cells are gelatinous and thick-walled.

all the Fresh-water Algæ, such as those which constitute the silky threads or green slime of running streams or standing pools, and which were all called Confervas before their immense diversity was known. Some are formed of a single row of cells, developed each from the end of another. Others branch, the top of one cell producing more than one new one

(Fig. 564). Others, of a kind which is very common in fresh water, simple threads made of a line of cells, have the chlorophyll and protoplasm of each cell arranged in spiral lines or bands.

They form spores in a peculiar way, which gives to this family the designation of conjugating Algæ.

512. At a certain time two parallel threads approach each other more closely; contiguous parts of



a cell of each thread bulge or grow out, and unite when they meet; the cell-wall partitions between them are absorbed so as to open a free communication; the spiral band of green matter in both cells breaks up; the whole of that of one cell passes over into the other; and of the united contents a large green spore is formed. Soon the old cells decay, and the spore

FIG. 564. The growing end of a branching Conferva (*Cladophora glomerata*), much magnified; showing how, by a kind of budding growth, a new cell is formed by a cross partition separating the newer tip from the older part below; also, how the branches arise.

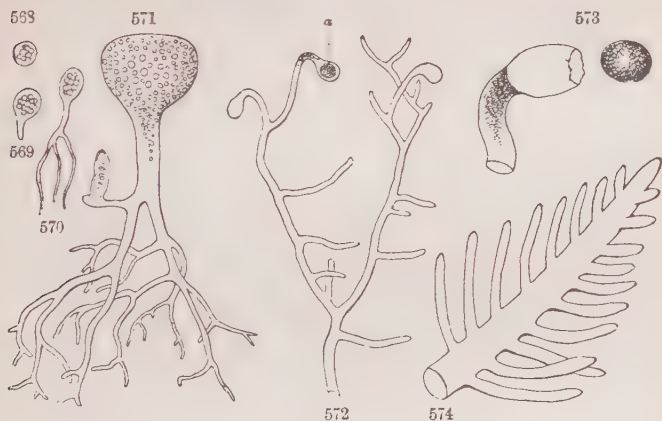
FIG. 565. Two magnified individuals of a *Spirogyra*, forming spores by conjugation; a completed spore at base: above, successive stages of the conjugation are represented.

FIG. 566. *Closterium acutum*, a common Desmid, moderately magnified. It is a single firm-walled cell, filled with green protoplasmic matter.

FIG. 567. More magnified view of three stages of the conjugation of a pair of the same.

set free is ready to germinate. Fig. 565 represents several stages of the conjugating process, which, however, would never be found all together like this in one pair of threads.

513. Desmids and Diatoms, which are microscopic one-celled plants of the same class, conjugate in the same way, as is shown in a *Closterium* by Fig. 566, 567. Here the whole living contents of two individuals are incorporated into one spore, for a fresh start. A reproduction which costs the life of two individuals to make a single new one would be fatal to the species if there were not a provision for multiplication by the prompt division of the new-formed individual into two, and these again into two, and so on in geometrical ratio. And the costly process would be meaningless if there were not some real advantage in such a fresh start, that is, in sexes.

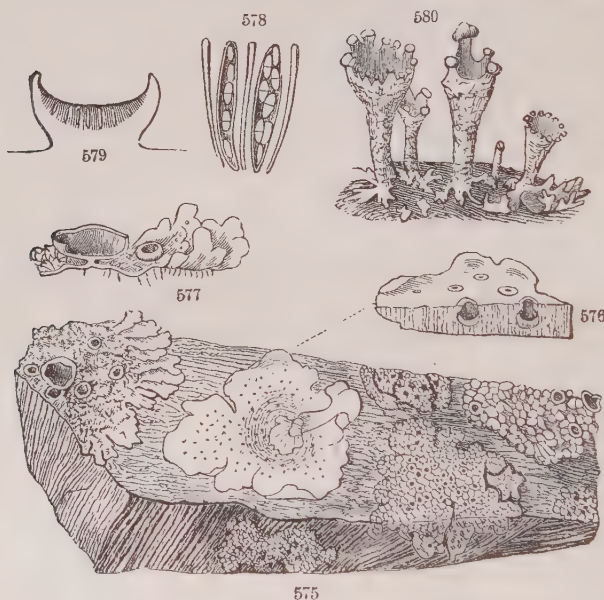


514. There are other Algae of the grass-green series which consist of single cells, but which by continued growth form plants of considerable size. Three kinds of these are represented in Fig. 568-574.

515. Lichens, Latin *Lichenes*, are to be studied in the works of the late Professor Tuckerman, but a popular exposition is greatly needed. The subjoined illustrations (Fig. 575-580) may simply indicate what some of the commoner forms are like. The cup, or shield-shaped spot, or knob, which bears the fructification is named the *Apothecium*. This is mainly

FIG. 568. Early stage of a species of *Botrydium*, a globose cell. 569, 570. Stages of growth. 571. Full-grown plant, extended and ramified below in a root-like way. 572. A *Vaucheria*; single cell grown on into a much-branched thread; the end of some branches enlarging, and the green contents in one (*a*) there condensed into a spore. 573. More magnified view of *a*, and the mature spore escaping. 574. *Bryopsis plumosa*; apex of a stem with its branchlets; all the extension of one cell. Various magnified.

composed of slender sacs (*Asci*), having thread-shaped cells intermixed; and each ascus contains few or several spores, which are commonly double or treble. Most Lichens are flat expansions of grayish hue; some of them foliaceous in texture, but never of bright green color; more are crustaceous; some are wholly pulverulent and nearly formless. But in several the vegetation lengthens into an axis (as in Fig. 580), or imitates stem



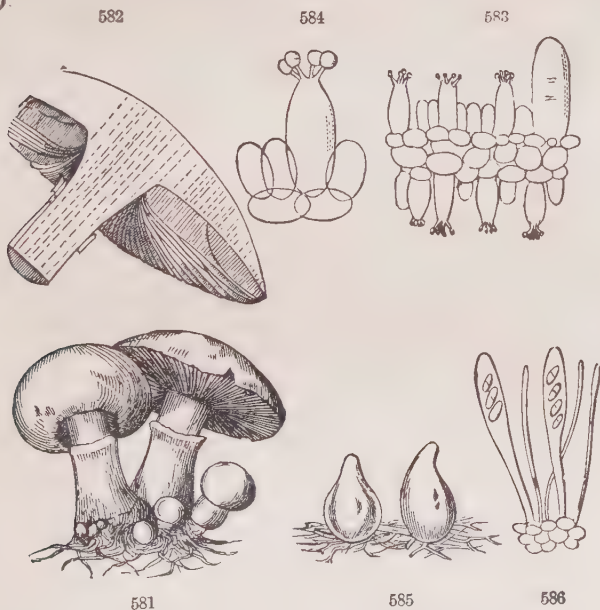
and branches or threads, as in the Reindeer-Moss on the ground in our northern woods, and the *Usnea* hanging from the boughs of old trees overhead.

516. **Fungi.** For this immense and greatly diversified class, it must here suffice to indicate the parts of a Mushroom, a *Sphæria*, and of one or two common Moulds. The true vegetation of common Fungi consists of slender cells which form what is called a *Mycelium*. These filamentous

FIG. 575. A stone on which various Lichens are growing, such as (passing from left to right) a *Parmelia*, a *Sticta*, and on the right, *Lecidia geographica*, so called from its patches resembling the outline of islands or continents as depicted upon maps. 576. Piece of thallus of *Parmelia conspersa*, with section through an apothecium. 577. Section of a smaller apothecium, enlarged. 578. Two asci of same, and contained spores, and accompanying filaments; more magnified. 579. Piece of thallus of a *Sticta*, with section, showing the immersed apothecia; the small openings of these dot the surface. 580. *Cladonia coccinea*; the fructification is in the scarlet knobs, which surround the cups.

cells lengthen and branch, growing by the absorption through their whole surface of the decaying, or organizable, or living matter which they feed upon. In a Mushroom (*Agaricus*), a knobby mass is at length formed, which develops into a stout stalk (*Stipe*), bearing the cap (*Pileus*): the under side of the cap is covered by the *Hymenium*, in this genus consisting of radiating plates, the gills or *Lamellæ*; and these bear the powdery spores in immense numbers. Under the microscope, the gills are found to be studded with projecting cells, each of which, at the top, produces four stalked spores. These form the powder which collects on a sheet of paper upon which a mature Mushroom is allowed to rest for a day or two. (Fig. 581-586.)

517. The esculent Morel, also *Sphæria* (Fig. 585, 586), and many other Fungi bear their spores in sacs (*asci*) exactly in the manner of Lichens (515).

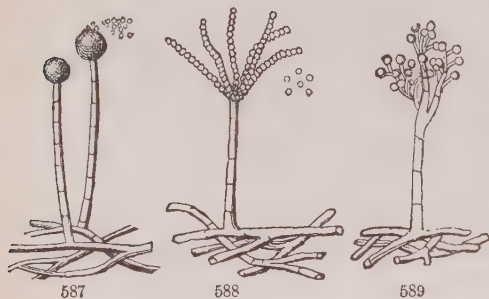


518. Of the Moulds, one of the commoner is the Bread-Mould (Fig. 587). In fruiting it sends up a slender stalk, which bears a globular sac;

FIG. 581. *Agaricus campestris*, the common edible Mushroom. 582. Section of cap and stalk. 583. Minute portion of a section of a gill, showing some spore-bearing cells, much magnified. 584. One of these, with its four spores, more magnified.

FIG. 585. *Sphæria rosella*. 586. Two of the asci and contained double spores, quite like those of a Lichen; much magnified.

this bursts at maturity and discharges innumerable spores. The blue Cheese-Mould (Fig. 588) bears a cluster of branches at top, each of which is a row of naked spores, like a string of beads, all breaking apart



at maturity. Botrytis (Fig. 589), the fruiting stalk of which branches, and each branch is tipped with a spore, is one of the many moulds which live and feed upon the juices of other plants or of animals, and are often very destructive.

The extremely numerous kinds of smut, rust, mildew, the ferments, bacteria, and the like, many of them very destructive to other vegetable and to animal life, are also low forms of the class of Fungi.¹

FIG. 587. *Ascophora*, the Bread-Mould. 588. *Aspergillus glaucus*, the mould of cheese, but common on mouldy vegetables. 589. A species of *Botrytis*. All magnified.

¹ The "Introduction to Cryptogamous Botany," or third volume of "The Botanical Text Book," now in preparation by the author's colleague, Professor Farlow, will be the proper guide in the study of the Flowerless Plants, especially of the Algæ and Fungi.

SECTION XVIII. CLASSIFICATION AND NOMENCLATURE.

519. Classification, in botany, is the consideration of plants in respect to their kinds and relationships. Some system of Nomenclature, or naming, is necessary for fixing and expressing botanical knowledge so as to make it available. The vast multiplicity of plants and the various degrees of their relationship imperatively require order and system, not only as to *names* for designating the kinds of plants, but also as to *terms* for defining their differences. Nomenclature is concerned with the names of plants. Terminology supplies names of organs or parts, and terms to designate their differences.

§ 1. KINDS AND RELATIONSHIP.

520. Plants and animals have two great peculiarities: 1st, they form themselves; and 2d, they multiply themselves. They reproduce their kind in a continued succession of

521. *Individuals.* Mineral things occur as *masses*, which are divisible into smaller and still smaller ones without alteration of properties. But organic things (vegetables and animals) exist as *individual beings*. Each owes its existence to a parent, and produces similar individuals in its turn. So each individual is a link of a chain; and to this chain the natural-historian applies the name of

522. *Species.* All the descendants from the same stock therefore compose one species. And it was from our observing that the several sorts of plants or animals steadily reproduce themselves, or, in other words, keep up a succession of similar individuals, that the idea of species originated. There are few species, however, in which man has actually observed the succession for many generations. It could seldom be proved that all the White Pine trees or White Oaks of any forest came from the same stock. But observation having familiarized us with the general fact that individuals proceeding from the same stock are essentially alike, we infer from their close resemblance that these similar individuals belong to the same species. That is, we infer it when the individuals are as much like each other as those are which we know, or confidently suppose, to have sprung from the same stock.

523. Identity in species is inferred from close similarity in all essential respects, or whenever the differences, however considerable, are not known or reasonably supposed to have been originated in the course of time under changed conditions. No two individuals are exactly alike; a tendency to variation pervades all living things. In cultivation, where variations are looked after and cared for, very striking differences come to light; and if in wild nature they are less common or less conspicuous, it is partly because they are uncared for. When such variant forms are pretty well marked they are called

524. **Varieties.** The White Oak, for example, presents two or three varieties in the shape of the leaves, although they may be all alike upon each particular tree. The question often arises, and it is often hard to answer, whether the difference in a particular case is that of a variety, or is specific. If the former, it may commonly be proved by finding such intermediate degrees of difference in various individuals as to show that no clear distinction can be drawn between them; or else by observing the variety to vary back again in some of its offspring. The sorts of Apples, Pears, Potatoes, and the like, show that differences which are permanent in the individual, and continue unchanged through a long series of generations when propagated by division (as by offsets, cuttings, grafts, bulbs, tubers, etc.), are not likely to be reproduced by seed. Still they sometimes are so, and perhaps always tend in that direction. For the fundamental law in organic nature is that offspring shall be like parent.

RACES are such strongly marked varieties, capable of coming true to seed. The different sorts of Wheat, Maize, Peas, Radishes, etc., are familiar examples. By selecting those individuals of a species which have developed or inherited any desirable peculiarity, keeping them from mingling with their less promising brethren, and selecting again the most promising plants raised from their seeds, the cultivator may in a few generations render almost any variety transmissible by seed, so long as it is cared for and kept apart. In fact, this is the way the cultivated domesticated races, so useful to man, have been fixed and preserved. Races, in fact, can hardly, if at all, be said to exist independently of man. But man does not really produce them. Such peculiarities — often surprising enough — now and then originate, we know not how (the plant *sports*, as the gardeners say); they are only preserved, propagated, and generally farther developed, by the cultivator's skilful care. If left alone, they are likely to dwindle and perish, or else revert to the original form of the species. Vegetable races are commonly annuals, which can be kept up only by seed, or herbs of which a succession of generations can be had every year or two, and so the education by selection be completed without great lapse of time. But all fruit-trees could probably be fixed into races in an equal number of generations.

BUD-VARIETIES are those which spring from buds instead of seed. They are uncommon to any marked extent. They are sometimes called *Sports*, but this name is equally applied to variations among seedlings.

CROSS-BREEDS, strictly so-called, are the variations which come from cross-fertilizing one variety of a species with another.

HYBRIDS are the varieties, if they may be so called, which come from the crossing of species (331). Only nearly related species can be hybridized; and the resulting progeny is usually self-sterile, but not always. Hybrid plants, however, may often be fertilized and made prolific by the pollen of one or the other parent. This produces another kind of cross-breeds.

525. Species are the units in classification. Varieties, although of

utmost importance in cultivation and of considerable consequence in the flora of any country, are of less botanical significance. For they are apt to be indefinite and to shade off one form into another. But species, the botanist *expects* to be distinct. Indeed, the practical difference to the botanist between species and varieties is the definite limitation of the one and the indefiniteness of the other. The botanist's determination is partly a matter of observation, partly of judgment.

526. In an enlarged view, varieties may be incipient species; and nearly related species probably came from a common stock in earlier times. For there is every reason to believe that existing vegetation came from the more or less changed vegetation of a preceding geological era. However that may be, species are regarded as permanent and essentially unchanged in their succession of individuals through the actual ages.

527. There are, at nearly the lowest computation, as many as one hundred thousand species of phanerogamous plants, and the cryptogamous species are thought to be still more numerous. They are all connected by resemblances or relationships, near and remote, which show that they are all parts of one system, realizations in nature, as we may affirm, of the conception of One Mind. As we survey them, they do not form a single and connected chain, stretching from the lowest to the highest organized species, although there obviously are lower and higher grades. But the species throughout group themselves, as it were, into clusters or constellations, and these into still more comprehensive clusters, and so on, with gaps between. It is this clustering which is the ground of the recognition of *kinds* of species, that is, of groups of species of successive grades or degree of generality; such as that of similar species into *Genera*, of genera into *Families* or *Orders*, of orders into *Classes*. In classification the sequence, proceeding from higher or more general to lower or special, is always CLASS, ORDER, GENUS, SPECIES, VARIETY (if need be).

528. *Genera* (in the singular, *Genus*) are assemblages of closely related species, in which the essential parts are all constructed on the same particular type or plan. White Oak, Red Oak, Scarlet Oak, Live Oak, etc., are so many species of the Oak genus (Latin, *Quercus*). The Chestnuts compose another genus; the Beeches another. The Apple, Pear, and Crab are species of one genus, the Quince represents another, the various species of Hawthorn a third. In the animal kingdom the common cat, the wild-cat, the panther, the tiger, the leopard, and the lion are species of the cat kind or genus; while the dog, the jackal, the different species of wolf, and the foxes, compose another genus. Some genera are represented by a vast number of species, others by few, very many by only one known species. For the genus may be as perfectly represented in one species as in several, although, if this were the case throughout, genera and species would of course be identical. The Beech genus and the Chestnut genus would be just as distinct from the Oak genus even if but one Beech and one Chestnut were known; as indeed was once the case.

529. **Orders** are groups of genera that resemble each other; that is, they are to genera what genera are to species. As familiar illustrations, the Oak, Chestnut, and Beech genera, along with the Hazel genus and the Hornbeams, all belong to one order. The Birches and the Alders make another; the Poplars and Willows, another; the Walnuts (with the Butternut) and the Hickories, still another. The Apple genus, the Quince and the Hawthorns, along with the Plums and Cherries and the Peach, the Raspberry with the Blackberry, the Strawberry, the Rose, belong to a large order, which takes its name from the Rose. Most botanists use the names "Order" and "Family" synonymously; the latter more popularly, as "the Rose Family," the former more technically, as "Order *Rosaceæ*."

530. But when the two are distinguished, as is common in zoölogy, Family is of lower grade than Order.

531. **Classes** are still more comprehensive assemblages, or great groups. Thus, in modern botany, the Dicotyledonous plants compose one class, the Monocotyledonous plants another (36-40).

532. These four grades, Class, Order, Genus, Species, are of universal use. Variety comes in upon occasion. For, although a species may have no recognized varieties, a genus implies at least one species belonging to it; every genus is of some order, and every order of some class.

533. But these grades by no means exhaust the resources of classification, nor suffice for the elucidation of all the distinctions which botanists recognize. In the first place, a higher grade than that of class is needful for the most comprehensive of divisions, that of all plants into the two *Series* of Phanerogamous and Cryptogamous (6); and in natural history there are the two *Kingdoms* or *Realms*, the Vegetable and the Animal.

534. Moreover, the stages of the scaffolding have been variously extended, as required, by the recognition of assemblages lower than class but higher than order, viz. *Subclass* and *Cohort*; or lower than order, a *Suborder*; or between this and genus, a *Tribe*; or between this and tribe, a *Subtribe*; or between genus and species, a *Subgenus*; and by some a species has been divided into *Subspecies*, and a variety into *Subvarieties*. Last of all are *Individuals*. Suffice it to remember that the following are the principal grades in classification, with the proper sequence; also that only those here printed in small capitals are fundamental and universal in botany:—

SERIES,

CLASS, Subclass, Cohort,

ORDER, or FAMILY, Suborder, Tribe, Subtribe,

GENUS, Subgenus or Section,

SPECIES, Variety.

§ 2. NAMES, TERMS, AND CHARACTERS.

535. The name of a plant is the name of its genus followed by that of the species. The name of the genus answers to the surname (or family name); that of the species to the baptismal name of a person. Thus *Quercus* is the name of the Oak genus; *Quercus alba*, that of the White Oak, *Q. rubra*, that of Red Oak, *Q. nigra*, that of the Black-Jack, etc. Botanical names being Latin or Latinized, the adjective name of the species comes after that of the genus.

536. **Names of Genera** are of one word, a substantive. The older ones are mostly classical Latin, or Greek adopted into Latin; such as *Quercus* for the Oak genus, *Fagus* for the Beech, *Corylus*, the Hazel, and the like. But as more genera became known, botanists had new names to make or borrow. Many are named from some appearance or property of the flowers, leaves, or other parts of the plant. To take a few examples from the early pages of the "Manual of the Botany of the Northern United States," — the genus *Hepatica* comes from the shape of the leaf, resembling that of the liver. *Myosurus* means mouse-tail. *Delphinium* is from dolphin, a dolphin, and alludes to the shape of the flower, which was thought to resemble the classical figures of the dolphin. *Xanthorrhiza* is from two Greek words meaning yellow-root, the common name of the plant. *Cimicifuga* is formed of two Latin words meaning to drive away bugs, i. e. Bugbane, the Siberian species being used to keep away such vermin. *Sanguinaria*, the Bloodroot, is named from the blood-like color of its juice. Other genera are dedicated to distinguished botanists or promoters of science, and bear their names: such are *Magnolia*, which commemorates the early French botanist, Magnol; and *Jeffersonia*, named after President Jefferson, who sent the first exploring expedition over the Rocky Mountains. Others bear the name of the discoverer of the plant; as, *Sarracenia*, dedicated to Dr. Sarrazin, of Quebec, who was one of the first to send the common Pitcher-plant to the botanists of Europe; and *Claytonia*, first made known by the early Virginian botanist Clayton.

537. **Names of Species.** The name of a species is also a single word, appended to that of the genus. It is commonly an adjective, and therefore agrees with the generic name in case, gender, etc. Sometimes it relates to the country the species inhabits; as, *Claytonia Virginica*, first made known from Virginia; *Sanguinaria Canadensis*, from Canada, etc. More commonly it denotes some obvious or characteristic trait of the species; as, for example, in *Sarracenia*, our northern species is named *purpurea*, from the purple blossoms, while a more southern one is named *flava*, because its petals are yellow; the species of *Jeffersonia* is called *diphylla*, meaning two-leaved, because its leaf is divided into two leaflets. Some species are named after the discoverer, or in compliment to a botanist who has made them known; as, *Magnolia Fraseri*, named after the botanist Fraser, one

of the first to find this species; and *Sarracenia Drummondii*, for a Pitcher-plant found by Mr. Drummond in Florida. Such personal specific names are of course written with a capital initial letter. Occasionally some old substantive name is used for the species; as *Magnolia Umbrella*, the Umbrella tree, and *Ranunculus Flammula*. These are also written with a capital initial, and need not accord with the generic name in gender. Geographical specific names, such as *Canadensis*, *Caroliniana*, *Americana*, in the later usage are by some written without a capital initial, but the older usage is better, or at least more accordant with English orthography.

538. **Varietal Names**, when any are required, are made on the plan of specific names, and follow these, with the prefix *var.* *Ranunculus Flammula*, var. *reptans*, the creeping variety: *R. abortivus*, var. *micranthus*, the small-flowered variety of the species.

539. In recording the name of a plant it is usual to append the name, or an abbreviation of the name, of the botanist who first published it; and in a flora or other systematic work, this reference to the source of the name is completed by a further citation of the name of the book, the volume and page where it was first published. So "*Ranunculus acris*, L.," means that this Buttercup was first so named and described by Linnæus; "*R. multifidus*, Pursh," that this species was so named and published by Pursh. The suffix is no part of the name, but is an abbreviated reference, to be added or omitted as convenience or definiteness may require. The authority for a generic name is similarly recorded. Thus, "*Ranunculus*, L.," means that the genus was so named by Linnæus; "*Myosurus*, Dill.," that the Mouse-tail was established as a genus under this name by Dillenius; *Caulophyllum*, Michx., that the Blue Cohosh was published under this name by Michaux. The full reference in the last-named instance would be, "in *Flora Boreali-Americana*, first volume, 205th page,"—in the customary abbreviation, "Michx. Fl. i. 205."

540. **Names of Orders** are given in the plural number, and are commonly formed by prolonging the name of a genus of the group taken as a representative of it. For example, the order of which the Buttercup or Crowfoot genus, *Ranunculus*, is the representative, takes from it the name of *Ranunculaceæ*; meaning *Plantæ Ranunculaceæ* when written out in full, that is, Ranunculaceous Plants. Some old descriptive names of orders are kept up, such as *Cruciferae* for the order to which Cress and Mustard belong, from the cruciform appearance of their expanded corolla, and *Umbelliferae*, from the flowers being in umbels.

541. **Names of Tribes**, also of suborders, subtribes, and the like, are plurals of the name of the typical genus, less prolonged, usually in *eæ*, *ineæ*, *ideæ*, etc. Thus the proper Buttercup tribe is *Ranunculeæ*, of the Clematis tribe, *Clematideæ*. While the Rose family is *Rosaceæ*, the special Rose tribe is *Roseæ*.

542. **Names of Classes**, etc. For these see the following synopsis of the actual classification adopted, p. 183.

543. So a plant is named in two words, the generic and the specific names, to which may be added a third, that of the variety, upon occasion. The generic name is peculiar; obviously it must not be used twice over in botany. The specific name must not be used twice over in the same genus, but is free for any other genus. A *Quercus alba*, or White Oak, is no hindrance to *Betula alba*, or White Birch; and so of other names.

544. **Characters and Descriptions.** Plants are *characterized* by a terse statement, in botanical terms, of their peculiarities or distinguishing marks. The character of the order should include nothing which is common to the whole class it belongs to; that of the genus, nothing which is common to the order; that of the species nothing which is shared with all other species of the genus; and so of other divisions. *Descriptions* may enter into complete details of the whole structure.

545. **Terminology**, also called *Glossology*, is nomenclature applied to organs or parts, and their forms or modifications. Each organ or special part has a substantive name of its own: shapes and other modifications of an organ or part are designated by adjective terms, or, when the forms are peculiar, substantive names are given to them. By the correct use of such botanical terms, and by proper subordination of the characters under the order, genus, species, etc., plants may be described and determined with much precision. The classical language of botany is Latin. While modern languages have their own names and terms, these usually lack the precision of the Latin or Latinized botanical terminology. Fortunately, this Latinized terminology has been largely adopted and incorporated into the English technical language of botany, thus securing precision. And these terms are largely the basis of specific names of plants.

546. A glossary or vocabulary of the principal botanical terms used in phanerogamous and vascular cryptogamous botany is appended to this volume, to which the student may refer, as occasion arises.

§ 3. SYSTEM.

547. Two systems of classification used to be recognized in botany, — the artificial and the natural; but only the latter is now thought to deserve the name of a system.

548. Artificial classifications have for object merely the ascertaining of the name and place of a plant. They do not attempt to express relationships, but serve as a kind of dictionary. They distribute the genera and species according to some one peculiarity or set of peculiarities (just as a dictionary distributes words according to their first letters), disregarding all other considerations. At present an artificial classification in botany is needed only as a key to the natural orders, — as an aid in referring an unknown plant to its proper family; and such keys are still very needful, at least for the beginner. Formerly, when the orders themselves were not clearly made out, an artificial classification was required to lead the

student down to the genus. Two such classifications were long in vogue: First, that of Tournefort, founded mainly on the leaves of the flower, the calyx and corolla: this was the prevalent system throughout the first half of the eighteenth century; but it has long since gone by. It was succeeded by the well-known

549. *Artificial System of Linnæus*, which was founded on the stamens and pistils. It consists of twenty-four classes, and of a variable number of orders; the classes founded mainly on the number and disposition of the stamens; the orders partly upon the number of styles or stigmas, partly upon other considerations. Useful and popular as this system was down to a time within the memory of still surviving botanists, it is now completely obsolete. But the tradition of it survives in the names of its classes, Monandria, Diandria, Triandria, etc., which are familiar in terminology in the adjective terms monandrous, diandrous, triandrous, etc. (284); also of the orders, Monogynia, Digynia, Trigynia, etc., preserved in the form of monogynous, digynous, trigynous, etc. (301); and in the name Cryptogamia, that of the 24th class, which is continued for the lower series in the natural classification.

550. *Natural System*. A genuine system of botany consists of the orders or families, duly arranged under their classes, and having the tribes, the genera, and the species arranged in them according to their relationships. This, when properly carried out, is the *Natural System*; because it is intended to express, as well as possible, the various degrees of relationship among plants, as presented in nature; that is, to rank those species and those genera, etc., next to each other in the classification which are really most alike in all respects, or, in other words, which are constructed most nearly on the same particular plan.

551. There can be only *one* natural system of botany, if by this term is meant the plan according to which the vegetable creation was called into being, with all its grades and diversities among the species, as well of past as of the present time. But there may be many natural systems, if we mean the attempts of men to interpret and express that plan, — systems which will vary with advancing knowledge, and with the judgment and skill of different botanists. These must all be very imperfect, bear the impress of individual minds, and be shaped by the current philosophy of the age. But the endeavor always is to make the classification answer to Nature, as far as any system can which has to be expressed in a definite and serial arrangement.

552. So, although the classes, orders, genera, etc., are natural, or as natural as the systematist can make them, their grouping or order of arrangement in a book, must necessarily be in great measure artificial. Indeed, it is quite impossible to arrange the orders, or even the few classes, in a single series, and yet have each group stand next to its nearest relatives on both sides.

553. Especially it should be understood that, although phanerogamous

plants are of higher grade than cryptogamous, and angiospermous or ordinary phanerogamous higher than the gymnospermous, yet there is no culmination in the vegetable kingdom, nor any highest or lowest order of phanerogamous plants.

554. The particular system most largely used at present in the classification of the orders is essentially the following : —

SERIES I. PHANEROGAMIA : PHANEROGAMOUS OR FLOWERING PLANTS.

CLASS I. DICOTYLEDONES ANGIOSPERMEÆ, called for shortness in English, DICOTYLEDONS or DICOTYLS. Ovules in a closed ovary. Embryo dicotyledonous. Stem with exogenous plan of growth. Leaves reticulate-veined,

Artificial Division I. POLYPETALÆ, with petals mostly present and distinct. Orders about 80 in number, *Ranunculaceæ* to *Cornaceæ*.

Artificial Division II. GAMOPETALÆ, with gamopetalous corolla. Orders about 45, *Caprifoliaceæ* to *Plantaginaceæ*.

Artificial Division III. APETALÆ or INCOMPLETÆ, with perianth, when present, of calyx only. Orders about 35 in number, from *Nyctaginaceæ* to *Salicaceæ*.

CLASS II. DICOTYLEDONES GYMNOSPERMEÆ, in English GYMNOSPERMS. No ovary or pericarp, but ovules and seeds naked, and no proper calyx nor corolla. Embryo dicotyledonous or polycotyledonous. Stem with exogenous plan of growth. Leaves mostly parallel-veined. Consists of order *Gnetaceæ*, which strictly connects with Angiospermous Dicotyls, of *Coniferæ*, and of *Cycadaceæ*.

CLASS III. MONOCOTYLEDONES, in English MONOCOTYLEDONS or MONOCOTYLS. Angiospermous. Embryo monocotyledonous. Stem with endogenous plan of growth. Leaves mostly parallel-veined.

Division I. PETALOIDEÆ. Perianth complete, having the equivalent of both calyx and corolla, and all the inner series corolline. About 18 orders.

Division II. CALYCINÆ. Perianth complete (in two series) but not corolline, mostly thickish or glumaceous. Chiefly two orders, *Juncaceæ*, the true Rushes, and *Palmæ*, Palms.

Division III. SPADICIFLOREÆ or NUDIFLOREÆ. Perianth none, or rudimentary and incomplete : inflorescence spadiceous. Of five orders, *Typhaceæ* and *Aroideæ* the principal.

Division IV. GLUMACEÆ. Perianth none, or very rudimentary : glumaceous bracts to the flowers. Orders mainly *Cyperaceæ* and *Gramineæ*.

SERIES II. CRYPTOGAMIA : CRYPTOGAMOUS OR FLOWERLESS PLANTS

CLASS I. PTERIDOPHYTA, PTERIDOPHYTES (484).

CLASS II. BRYOPHYTA, BRYOPHYTES (498).

CLASS III. THALLOPHYTA, THALLOPHYTES (503).

SECTION XIX. BOTANICAL WORK.

555. Some hints and brief instructions for the collection, examination, and preservation of specimens are added. They are especially intended for the assistance of those who have not the advantage of a teacher. They apply to phanerogamous plants and Ferns only, and to systematic botany.¹

§ 1. COLLECTION, OR HERBORIZATION.

556. As much as possible, plants should be examined in the living state, or when freshly gathered. But dried specimens should be prepared for more leisurely examination and for comparison. To the working botanist good dried specimens are indispensable.

557. **Botanical Specimens**, to be complete, should have root or root-stock, stem, leaves, flowers, both open and in bud, and fruit. Sometimes these may all be obtained at one gathering; more commonly two or three gatherings at different times are requisite, especially for trees and shrubs.

558. In **Herborizing**, a good knife and a narrow and strong trowel are needed; but a very strong knife will serve instead of a trowel or small pick for digging out bulbs, tubers, and the like. To carry the specimens, either the tin box (*vasculum*) or a portfolio, or both are required. The tin box is best for the collection of specimens to be used fresh, as in the class-room; also for very thick or fleshy plants. The portfolio is indispensable for long expeditions, and is best for specimens which are to be preserved in the herbarium.

559. The *Vasculum*, or *Botanical Collecting-box*, is made of tin, in shape like a candle-box, only flatter, or the smaller sizes like an English sandwich-case; the lid opening for nearly the whole length of one side of the box. Any portable tin box of convenient size, and capable of holding specimens a foot or fifteen inches long, will answer the purpose. The box should shut close, so that the specimens may not wilt: then it will keep leafy branches and most flowers perfectly fresh for a day or two, especially if slightly moistened. They should not be wet.

560. The *Portfolio* is best made of two pieces of solid binder's-board, covered with enamel cloth, which also forms the back, and fastened by straps and buckles. It may be from a foot to twenty inches long, from nine to eleven or twelve inches wide. It should contain a needful quantity of smooth but strong and pliable paper (thin so-called Manilla paper is best), either fastened at the back as in a book, or loose in folded sheets when not very many specimens are required. As soon as gathered, the specimens should be separately laid between the leaves or in the folded sheets, and kept under moderate pressure in the closed portfolio.

¹ For fuller directions in many particulars, see "Structural Botany," pp. 370-374.

561. Of small herbs, especially annuals, the whole plant, root and all, should be taken for a specimen. Of larger ones branches will suffice, with some leaves from near the root. Enough of the root or subterranean part of the plant should be collected to show whether it is an annual, a biennial, or a perennial. Thick roots, bulbs, tubers, or branches of specimens intended to be pressed should be thinned with a knife, or cut into slices. Keep the specimens within the length of fifteen or sixteen inches, by folding, or when that cannot be done, by cutting into lengths.

562. **For Drying Specimens** a good supply of soft and unsized paper is wanted; and some convenient means of applying considerable pressure. To make good dried botanical specimens, dry them as rapidly as possible between many thicknesses of sun-dried paper to absorb their moisture, under as much pressure as can be given without crushing the more delicate parts. This pressure may be had by a botanical press, of which various forms have been contrived; or by weights placed upon a board,—from forty to eighty or a hundred pounds, according to the quantity of specimens drying at the time. For use while travelling, a good portable press may be made of thick binders' boards for the sides, and the pressure may be applied by strong straps with buckles. Still better, on some accounts, are portable presses made of wire network, which allow the dampness to escape by evaporation between the meshes. For herborization in a small way, a light wire-press may be taken into the field and made to serve also as a portfolio.

563. It is well to have two kinds of paper, namely, *driers* of bibulous paper, stitched into pads (or the pads may be of thick carpet-paper, cut to size) and thin smooth paper, folded once; the specimens to be laid into the fold, either when gathered or on returning from the excursion. These sheets are to hold the specimens until they are quite dry. Every day, or at first even twice a day, the specimens, left undisturbed in their sheets, are to be shifted into fire-dried or sun-dried fresh driers, and the pressure renewed, while the moist sheets are spread out to dry, so as to take their turn again at the next shifting. This course must be continued until the specimens are no longer moist to the touch. Good and comely specimens are either made or spoiled within the first twenty-four or thirty-six hours. After that, when plenty of driers are used, it may not be necessary to change them so frequently.

564. Succulent plants, which long refuse to part with life and moisture, and Spruces and some other evergreens which are apt to cast off their leaves, may be plunged for a moment into boiling water, all but the flowers. Delicate flowers may be encased in thin tissue paper when put into the press. Thick parts, like the heads of Sun-flowers and Thistles, may be cut in two or into slices.

565. Dried specimens may be packed in bundles, either in folded paper or upon single half-sheets. It is better that such paper should not be bibulous. The packages should be well wrapped or kept in close cases

566. **Poisoning** is necessary if specimens are to be permanently preserved from the depredation of insects. The usual application is an almost saturated solution of corrosive sublimate in 95 per cent alcohol, freely applied with a large and soft brush, or the specimens dipped into some of the solution poured into a large and flat dish; the wetted specimens to be transferred for a short time to driers.

§ 2. HERBARIUM.

567. The botanist's collection of dried specimens, ticketed with their names, place, and time of collection, and systematically arranged under their genera, orders, etc., forms a *Hortus Siccus* or *Herbarium*. It comprises not only the specimens which the proprietor has himself collected, but those which he acquires through friendly exchanges, or in other ways. The specimens of an herbarium may be kept in folded sheets of paper; or they may be fastened on half-sheets of thick and white paper, either by gummed slips, or by glue applied to the specimens themselves. The former is best for private and small herbaria; the latter for large ones which are much turned over. Each sheet should be appropriated to one species; two or more different plants should never be attached to the same sheet. The generic and specific name of the plant should be added to the lower right-hand corner, either written on the sheet, or on a ticket pasted down; and the time of collection, the locality, the color of the flowers, and any other information which the specimens themselves do not afford, should be duly recorded upon the sheet or the ticket. The sheets of the herbarium should all be of exactly the same dimensions. The herbarium of Linnæus is on paper of the common foolscap size, about eleven inches long and seven wide. This is too small. Sixteen and three eighths inches by eleven and a half inches is an approved size.

568. The sheets containing the species of each genus are to be placed in *genus-covers*, made of a full sheet of thick paper (such as the strongest Manilla-hemp paper), to be when folded of the same dimensions as the species-sheet but slightly wider: the name of the genus is to be written on one of the lower corners. These are to be arranged under the orders to which they belong, and the whole kept in closed cases or cabinets, either laid flat in compartments, like "pigeon-holes," or else placed in thick portfolios, arranged like folio volumes. All should be kept, as much as practicable, in dust-proof and insect-proof cases or boxes.

569. Fruits, tubers, and other hard parts, too thick for the herbarium, may be kept in pasteboard or light wooden boxes, in a collection apart. Small loose fruits, seeds, detached flowers, and the like may be conveniently preserved in paper capsules or envelopes, attached to the herbarium-sheets.

§ 3. INVESTIGATION AND DETERMINATION OF PLANTS.

570. **The Implements** required are a hand magnifying glass, a pocket lens of an inch or two focus, or a glass of two lenses, one of the lower and the other of the higher power; and a sharp penknife for dissection. With these and reasonable perseverance the structure of the flowers and fructification of most phanerogamous plants and Ferns can be made out. But for ease and comfort, as well as for certainty and right training, the student should have some kind of simple stage microscope, and under this make all dissections of small parts. Without it the student will be apt to fall into the bad habit of guessing where he ought to ascertain.

571. The simple microscope may be reduced to a good lens or doublet, of an inch focus, mounted over a glass stage, so that it can be moved up and down and also sidewise, and with (or without) a little mirror underneath. A better one would have one or two additional lenses (say of half and of a quarter inch focus), a pretty large stage, on the glass of which several small objects can be placed and conveniently brought under the lens; and its height or that of the lens should be adjustable by a rack-work; also a swivel-mounted little mirror beneath, which is needed for minute objects to be viewed by transmitted light.

572. For dissecting and displaying small parts on the stage of the microscope, besides a thin-bladed knife, the only tools needed are a good stock of common needles of various sizes, mounted in handles, and one or more saddler's-needles, which, being triangular, may be ground to sharp edges convenient for dissection. Also a pair of delicate-pointed forceps; those with curved points used by the dentist are most convenient. A cup of clean water is indispensable, with which to moisten or wet, or in which occasionally to float delicate parts. Small flowers, buds, fruits, and seeds of dried specimens can be dissected quite as well as fresh ones. They have only to be soaked in warm or boiling water.

573. The compound microscope is rarely necessary except in cryptogamic botany and vegetable anatomy; but it is very useful and convenient, especially for the examination of pollen. To the advanced botanist it is a necessity, to all students of botany an aid and delight.

574. **Analysis.** A few directions and hints may be given. The most important is this: In studying an unknown plant, make a complete examination of all its parts, and form a clear idea of its floral structure and that of its fruit, from pericarp down to the embryo, or as far as the materials in hand allow, before taking a step toward finding out its name and relationship by means of the keys or other helps which the Manuals and Floras provide. If it is the name merely that is wanted, the shorter way is to ask some one who already knows it. To verify the points of structure one by one as they happen to occur in an artificial key, without any preparatory investigation, is a usual but is not the best nor the surest

way. It is well to make drawings or outline sketches of the smaller parts, and especially diagrams of the plan of the flower, such as those of Fig. 225, 227, 241, 244, 275-277. For these, cross sections of the flower-bud or flower are to be made: and longitudinal sections, such as Fig. 270-274, are equally important. The dissection even of small seeds is not difficult after some practice. Commonly they need to be soaked or boiled

575. The right appreciation of characters and terms used in description needs practice and calls for judgment. Plants do not grow exactly by rule and plummet, and measurements must be taken loosely. Difference of soil and situation are responded to by considerable variations, and other divergences occur which cannot be accounted for by the surroundings, nor be anticipated in general descriptions. Annuals may be very depauperate in dry soils or seasons, or very large when particularly well nourished. Warm and arid situations promote, and wet ones are apt to diminish pubescence. Soft water causes increased succulence. The color of flowers is apt to be lighter in shade, and brighter in open and elevated situations. A color or hue not normal to the species now and then occurs, which nothing in the conditions will account for. *A white-flowered variation of any other colored blossom may always be expected*; this, though it may be notable, no more indicates a distinct variety of the species than an albino would a variety of the human species. The numerical plan is subject to variation in some flowers; those on the plan of five may now and then vary to four or to six. Variations of the outline or lobing of leaves are so familiar that they do not much mislead. Only wider and longer observation suffices to prevent or correct mistakes in botanical study. But the weighing of evidence and the balancing of probabilities, no less than the use of the well-ordered and logical system of classification, give an excellent training to the judgment as the search for the facts themselves does to the observing powers.

§ 4. SIGNS AND ABBREVIATIONS

576. For a full account of these, whether of former or actual use, see "Structural Botany" of the "Botanical Text Book," pp. 367, 392, as also for the principles which govern the accentuation of names. It is needful here to explain only those used in the Manuals and Floras of this country, for which the present volume is an introduction and companion. They are not numerous.

577. In arranging the species, at least those of a large genus, the divisions are denoted and graduated as follows: The sign § is prefixed to sections of the highest rank: these sections when they have names affixed to them (as PRUNUS § CERASUS) may be called subgenera. When the divisions of a genus are not of such importance, or when divisions are made under the subgenus itself, the most comprehensive ones are marked by asterisks, * for the first, * * for the second, and so on. Subdivisions are

marked with a prefixed +; those under this head with ++; and those under this with =, if there be so many grades. A similar notation is followed in the synopsis of the genera of an order.

578. The interrogation point is used in botany to indicate doubt. Thus *Clematis crispa*, L.? expresses a doubt whether the plant in question is really the *Clematis crispa* of Linnæus. *Clematis? polypetala* expresses a doubt whether the plant so named is really a *Clematis*. On the other hand the exclamation point (!) is used to denote certainty whenever there is special need to affirm this.

579. For size or height, the common signs of degrees, minutes, and seconds, have been used, thus, 1°, 2', 3'', stand respectively for a foot, two inches, and three lines or twelfths of an inch. A better way, when such brevity is needed, is to write 1^a. 2ⁱⁿ. 3^l.

580. Signs for duration used by Linnæus were ☉ for an annual, ♂ for a biennial, ♀ for a perennial herb, 5 for a shrub or tree. DeCandolle brought in ☉ for a plant that died after once flowering, ① if annual, ② if biennial.

581. To indicate sexes, ♂ means staminate or male plant or blossom; ♀, pistillate or female; ♂, perfect or hermaphrodite.

582. To save room it is not uncommon to use ∞ in place of "many;" thus, "Stamens ∞," for stamens indefinitely numerous: "∞ flora" for pluriflora or many-flowered. Still more common is the form "Stamens 5-20," or "Calyx 4-5-parted," for stamens from five to twenty, calyx four-parted or five-parted, and the like. Such abbreviations hardly need explanation.

583. The same may be said of such abbreviations as *Cal.* for calyx, *Cor.* for corolla, *Pet.* for petals, *St.* for stamens, *Pist.* for pistil, *Hab.* for habitat, meaning place of growth, *Herb.* for herbarium, *Hort.* for garden. Also *l. c.*, loco citato, which avoids repetition of volume and page.

584. "Structural Botany" has six pages of abbreviations of the names of botanists, mostly of botanical authors. As they are not of much consequence to the beginner, while the more advanced botanist will know the names in full, or know where to find them, only a selection is here appended.

ABBREVIATIONS OF THE NAMES OF BOTANISTS.

<i>Adans.</i>	= Adanson.	<i>Gmel.</i>	= Gmelin.
<i>Ait.</i>	Aiton.	<i>Good.</i>	Goodenough.
<i>All.</i>	Allioni.	<i>Grev.</i>	Greville.
<i>Andr.</i>	Andrews.	<i>Griseb.</i>	Grisebach.
<i>Arn.</i>	Arnott.	<i>Gron.</i>	} Gronovius.
<i>Aub.</i>	Aublet.	<i>Gronov.</i>	
<i>Bartr.</i>	Bartram.	<i>Hall.</i>	Haller.
<i>Beauv.</i>	Palisot de Beauvois.	<i>Hartm.</i>	Hartmann.
<i>Benth.</i>	Bentham.	<i>Hartw.</i>	Hartweg.
<i>Bernh.</i>	Bernhardi.	<i>Harv.</i>	Harvey.
<i>Bigel.</i>	Jacob Bigelow.	<i>Haw.</i>	Haworth.
<i>Bong.</i>	Bongard.	<i>Hegelm.</i>	Hegelmaier.
<i>Bonpl.</i>	Bonpland.	<i>Hemsl.</i>	Hemsley.
<i>Br. or R. Br.</i>	Robert Brown.	<i>Herb.</i>	Herbert.
<i>Cass.</i>	Cassini.	<i>Hoffm.</i>	Hoffmann.
<i>Cav.</i>	Cavanilles.	<i>Hoffmans.</i>	Hoffmansegg.
<i>Cham.</i>	Chamisso.	<i>Hook.</i>	Hooker.
<i>Chapm.</i>	Chapman.	<i>Hook. f.</i>	J. D. Hooker.
<i>Choisy.</i>	Choisy.	<i>Hornem.</i>	Hornemann.
<i>Clayt.</i>	Clayton.	<i>Huds.</i>	Hudson.
<i>Curt.</i>	Curtis.	<i>Humb.</i>	Humboldt. { Kunth.
<i>Curt. (M. A.)</i>	M. A. Curtis.	<i>HBK.</i>	Humboldt, Bonpland, and
<i>Darl.</i>	Darlington.	<i>Jacq.</i>	Jacquin.
<i>DC.</i>	} DeCandolle.	<i>Jacq. f.</i>	J. F. Jacquin.
<i>DeCand.</i>		<i>Juss.</i>	Jussieu.
<i>A. DC.</i>	Alphonse DeCandolle.	<i>A. Juss.</i>	Adrien de Jussieu.
<i>Desc.</i>	Descourtilz.	<i>Kit.</i>	Kitaibel.
<i>Desf.</i>	Desfontaines.	<i>L. or Linn.</i>	Linnaeus.
<i>Desv.</i>	Desvaux.	<i>Labill.</i>	Labillardiere.
<i>Dill.</i>	Dillenius.	<i>Lag.</i>	Lagasca.
<i>Dougl.</i>	Douglas.	<i>Lam.</i>	Lamareck.
<i>Duham.</i>	Duhamel.	<i>Ledeb.</i>	Ledebour.
<i>Dun.</i>	Dunal.	<i>Lehm.</i>	Lehmann.
<i>Eat.</i>	Eaton (Amos) or D. C.	<i>Lesq.</i>	Ilesquercux.
<i>Ehrh.</i>	Ehrhart.	<i>Less.</i>	Lessing.
<i>Ell.</i>	Elliott.	<i>Lestib.</i>	Lestibudois.
<i>Endl.</i>	Endlicher.	<i>L'Her.</i>	L'Heritier.
<i>Engelm.</i>	Engelmann.	<i>Lindb.</i>	Lindberg.
<i>Engl.</i>	Engler.	<i>Lindh.</i>	Lindheimer.
<i>Fisch.</i>	Fischer.	<i>Lindl.</i>	Lindley.
<i>Frœl.</i>	Frœlich.	<i>Lodd.</i>	Loddiges.
<i>Gærtn.</i>	Gartner.	<i>Loud.</i>	Loudon.
<i>Gaud.</i>	Gaudin.	<i>M. Bieb.</i>	Marschall von Bieberstein.
<i>Gaudich.</i>	Gaudichaud.	<i>Marsh.</i>	Marshall (Humphrey).
<i>Ging.</i>	Gingius.	<i>Mart.</i>	Martius.

<i>Mast.</i>	= Masters.
<i>Maxim.</i>	Maximowicz.
<i>Meisn.</i>	} Meisner or Meissner.
<i>Meissn.</i>	
<i>Michx. or Mr.</i>	Michaux.
<i>Michx. f.</i>	F. A. Michaux.
<i>Mill.</i>	Miller.
<i>Miq.</i>	Miquel.
<i>Mitch.</i>	Mitchell.
<i>Moç.</i>	Moçino.
<i>Moq.</i>	Moquin-Tandon.
<i>Moric.</i>	Moricand.
<i>Moris.</i>	Morison.
<i>Muell. Arg.</i>	J. Mueller.
<i>Muell. (F.)</i>	Ferdinand Mueller.
<i>Muhl.</i>	Muhlenberg.
<i>Murr.</i>	Murray.
<i>Naud.</i>	Naudin.
<i>Neck.</i>	Necker.
<i>Nees</i>	} Nees von Esenbeck.
<i>N. ab E.</i>	
<i>Nutt.</i>	Nuttall.
<i>Æd.</i>	Æder.
<i>Ort.</i>	Ortega.
<i>P. de Beauv.</i>	Palisot de Beauvois.
<i>Pall.</i>	Pallas.
<i>Parl.</i>	Parlatore.
<i>Pav.</i>	Pavon.
<i>Pers.</i>	Persoon.
<i>Planch.</i>	Planchon.
<i>Pluk.</i>	Pluk ^{et} .
<i>Plum.</i>	Plumier.
<i>Poir.</i>	Poiret.
<i>Radlk.</i>	Radlkofer.
<i>Raf.</i>	Rafinesque.
<i>Red.</i>	Redouté.
<i>Reichenb.</i>	Reichenbach.
<i>Rich.</i>	L. C. Richard.
<i>Rich. f. or A.</i>	Achille Richard.
<i>Richards.</i>	Richardson.
<i>Ridd.</i>	Riddell.

Rœm. & Schult. = Rœmer & Schultes.

<i>Rottb.</i>	Rottbæll.
<i>Rupr.</i>	Ruprecht.
<i>St. Hil.</i>	Saint-Hilaire.
<i>Salisb.</i>	Salisbury.
<i>Schk.</i>	Schkuhr.
<i>Schlecht.</i>	Schlechtendal.
<i>Schrad.</i>	Schrader.
<i>Schreb.</i>	Schreber.
<i>Schwein.</i>	Schweinitz.
<i>Scop.</i>	Scopoli.
<i>Spreng.</i>	Sprengel.
<i>Sternb.</i>	Sternberg.
<i>Steud.</i>	Steudel.
<i>Sull.</i>	Sullivant.
<i>Thunb.</i>	Thunberg.
<i>Torr.</i>	Torrey.
<i>Tourn.</i>	Tournefort.
<i>Trautv.</i>	Trautvetter.
<i>Trin.</i>	Trinius.
<i>Tuck.</i>	Tuckerman.
<i>Vaill.</i>	Vaillant.
<i>Vent.</i>	Ventenat.
<i>Vill.</i>	Villars.
<i>Wahl.</i>	Wahlenberg.
<i>Walds.</i>	Waldstein.
<i>Wall.</i>	Wallich.
<i>Wallr.</i>	Wallroth.
<i>Walp.</i>	Walpers.
<i>Walt.</i>	Walter.
<i>Wang.</i>	Wangenheim.
<i>Wats.</i>	Sereno Watson, unless other initials are given.
<i>Wedd.</i>	Weddell.
<i>Wendl.</i>	Wendland.
<i>Wiks.</i>	Wikstrom.
<i>Willd.</i>	Willdenow.
<i>Wulf.</i>	Wulfen.
<i>Zucc.</i>	Zuccarini.
<i>Zuccag.</i>	Zuccagini.

GLOSSARY AND INDEX,

OR

DICTIONARY OF THE PRINCIPAL TERMS IN DESCRIPTIVE BOTANY, COMBINED WITH AN INDEX.

For the convenience of unclassical students, the commoner Latin and Greek words (or their equivalents in English form) which enter into the composition of botanical names, as well as of technical terms, are added to this Glossary. The numbers refer to pages.

A, at the beginning of words of Greek derivation, commonly signifies a negative, or the absence of something; as *apetalous*, without petals; *aphyllous*, leafless, &c. In words beginning with a vowel, the prefix is *an*; as *anantherous*, destitute of anther.

Abnormal, contrary to the usual or the natural structure.

Aboriginal, original in the strictest sense; same as *indigenous*.

Abortive, imperfectly formed, or rudimentary.

Abortion, the imperfect formation or the non-formation of some part.

Abrupt, suddenly terminating; as, for instance,

Abruptly pinnate, pinnate without an odd leaflet at the end, 58.

Acantho-, spiny.

Acaulescent (*acaulis*), apparently stemless; the proper stem, bearing the leaves and flowers, being very short or subterranean.

Accessory, something additional; as *Accessory buds*, 30, 31; *Accessory fruits*, 118.

Accrescent, growing larger after flowering.

Accrete, grown to.

Accumbent, lying against a thing. The cotyledons are *accumbent* when they lie with their edges against the radicle, 128.

Acephalous, headless.

Acerose, needle-shaped, as the leaves of Pines.

Acetabuliform, saucer-shaped.

Achænum, or *Achenium* (plural *achenia*), a one-seeded, seed-like fruit, 120.

Achlamydeous (flower), without floral envelopes, 86.

Acicular, needle-shaped; more slender than *acerose*.

Acinaciform, scimitar-shaped, like some bean-pods.

Acines, the separate grains of a fruit, such as the raspberry.

Acorn, the nut of the Oak, 122.

Acotyledonous, destitute of cotyledons or seed-leaves.

Acrogenous, growing from the apex, as the stems of Ferns and Mosses. *Acrogens*, or *Acrogenous Plants*, a name for the vascular cryptogamous plants, 156.

Aculeate, armed with prickles, i. e. *aculei*; as the Rose and Brier.

Aculeolate, armed with small prickles, or slightly prickly.

Acuminate, taper-pointed, 54.

Acute, merely sharp-pointed, or ending in a point less than a right angle, 54.

- Adelphous* (stamens), joined in a fraternity (*adelfhia*); see *monadelphous*, &c.
- Aden*, Greek for gland. So *Adenophorous*, gland-bearing.
- Adherent*, sticking to, or more commonly, growing fast to another body.
- Adnate*, literally, growing fast to, born adherent, 95. The anther is adnate when fixed by its whole length to the filament or its prolongation, 101.
- Adnation*, the state of being adnate, 94.
- Adpressed* or *appressed*, brought into contact with, but not united.
- Adscendent*, *ascendent*, or *ascending*, rising gradually upwards, 39.
- Adsurgent*, or *assurgent*, same as ascending, 39.
- Adventitious*, out of the proper or usual place; e. g. *Adventitious buds*, 30.
- Adventive*, applied to foreign plants accidentally or sparingly introduced into a country, but hardly to be called naturalized.
- Æquilateral*, equal-sided; opposed to oblique.
- Aerial roots*, &c., 36.
- Æruginous*, verdigris-colored.
- Æstival*, produced in summer.
- Æstivation*, the arrangement of parts in a flower-bud, 97.
- Agamous*, sexless.
- Aggregate fruits*, 118.
- Agrestis*, growing in fields.
- Air-cells* or *Air-passages*, spaces in the tissue of leaves and some stems, 131.
- Air-Plants*, 36.
- Akene* or *Akenium*, 120.
- Ala* (plural, *alæ*), a wing; the side-petals of a papilionaceous corolla, 92.
- Alabastrum*, a flower-bud.
- Alar*, situated in the forks of a stem.
- Alate*, winged.
- Albescent*, whitish, or turning white.
- Albus*, Latin for white.
- Albumen* of the seed, nourishing matter stored up with the embryo, 21, 127.
- Albumen*, a vegetable product, of four elements.
- Albuminous* (seeds), furnished with albumen, 21.
- Alburnum*, young wood, sap-wood, 142.
- Alliaceus*, with odor of garlic.
- Allogamous*, close fertilization.
- Alpestrine*, subalpine.
- Alpine*, belonging to high mountains above the limit of forests.
- Alternate* (leaves), one after another, 29, 67. Petals are *alternate* with the sepals, or stamens with the petals, when they stand over the intervals between them, 82.
- Alveolate*, honeycomb-like.
- Ament*, the scaly spike of trees like the Birch and Willow, 75.
- Amentaceous*, catkin-like, or catkin-bearing.
- Amorphous*, shapeless, without any definite form.
- Amphicarpous*, producing two kinds of fruit.
- Amphigastrium* (plural, *amphigastria*), a peculiar stipule-like leaf of Liverworts.
- Amphitropous*, ovules or seeds, 111.
- Amphora*, a pitcher-shaped organ.
- Amplectant*, embracing. *Amplexicaul* (leaves), clasping the stem by the base.
- Ampullaceous*, swelling out like a bottle or bladder (*ampulla*).
- Amylaceous*, *Amyloid*, composed of starch (*amylum*), or starch-like.
- Anandrous*, without stamens.
- Anantherous*, without anthers. *Ananthous*, destitute of flowers; flowerless.
- Anastomosing*, forming a net-work (*anastomosis*), as the veins of leaves, 50.
- Anatropous* ovules or seeds, 111.
- Ancipital* (*anceps*), two-edged.
- Andræcium*, a name for the stamens taken together, 98.

- Andro-diœcious*, flowers staminate on one plant, perfect on another.
- Androgynous*, having both staminate and pistillate flowers in the same cluster.
- Androphore*, a column of united stamens, as in a Mallow.
- Androus*, or *Ander*, *andra*, *andrum*, Greek in compounds for male, or stamens.
- Anemophilous*, wind-loving, said of wind-fertilizable flowers, 113.
- Anfractuose*, bent hither and thither as the anthers of the Squash, &c.
- Angiospermæ*, *Angiospermous*, with seeds formed in an ovary or pericarp, 109.
- Angular divergence* of leaves, 69.
- Anisos*, unequal. *Anisomerous*, parts unequal in number. *Anisopetalous*, with unequal petals. *Anisophyllous*, the leaves unequal in the pairs.
- Annual* (plant), flowering and fruiting the year it is raised from the seed, and then dying, 37.
- Annular*, in the form of a ring, or forming a circle.
- Annulate*, marked by rings; or furnished with an
- Annulus*, or ring, like that of the spore-case of most Ferns. In Mosses it is a ring of cells placed between the mouth of the spore-case and the lid in many species.
- Annotinous*, yearly, or in yearly growths.
- Anterior*, in the blossom, is the part next the bract, i. e. external; while the posterior side is that next the axis of inflorescence. Thus, in the Pea, &c., the keel is *anterior*, and the standard *posterior*, 96.
- Anthela*, an open paniculate cyme.
- Anther*, the essential part of the stamen, which contains the pollen, 14, 80, 101.
- Antheridium* (plural *antheridia*), the organ in Cryptogams which answers to the anther of Flowering Plants, 150.
- Antheriferous*, anther-bearing.
- Anthesis*, the period or the act of the expansion of a flower.
- Anthocarpus* (fruits), 118.
- Anthophore*, a stipe between calyx and corolla, 113.
- An hos*, Greek for flower; in composition, *Monanthous*, one-flowered, &c
- Anticous*, same as anterior.
- Antrorse*, directed upwards or forwards.
- Apetalous*, destitute of petals, 86.
- Aphyllous*, leafless.
- Apical*, belonging to the apex or point.
- Apiculate*, pointleted; tipped with a small point.
- Apocarpous* (pistils), when the several pistils of the same flower are separate.
- Apophysis*, any irregular swelling; the enlargement at the base of the spore-case of the Umbrella-Moss.
- Apothecium*, the fructification of Lichens, 171.
- Appendage*, any superadded part. *Appendiculate*, provided with appendages.
- Appressed*, close pressed to the stem, &c.
- Apricus*, growing in dry and sunny places.
- Apterous*, wingless.
- Aquatic* (*Aquatilis*), living or growing in water; applied to plants whether growing under water, or with all but the base raised out of it.
- Arachnoid*, *Araneose*, cobwebby; clothed with, or consisting of, soft downy fibres.
- Arboreous*, *Arborescent*, tree-like, in size or form, 39.
- Arboretum*, a collection of trees.
- Archegonium* (plural *archegonia*), the organ in Mosses, &c., which is analogous to the pistil of Flowering Plants.
- Arcuate*, bent or curved like a bow.
- Arenose* (*Arenarius*), growing in sand.
- Areolate*, marked out into little spaces or *areolæ*.
- Argenteous*, or *Argentate*, silvery-like.
- Argillose*, growing in clay.
- Argos*, Greek for pure white; *Argophyllous* or *Argyrophyllous*, white-leaved, &c.
- Argutus*, acutely dentate.

Arillate (seeds) furnished with an aril.

Arilliform, aril-like.

Arillus, or *Aril*, a fleshy growth from base of a seed, 126.

Aristate, awned, i. e. furnished with an *arista*, like the beard of Barley, &c., 54.

Aristulate, diminutive of the last; short-awned.

Arrect, brought into upright position.

Arrow-shaped or *Arrow-headed*, same as *sagittate*, 53.

Articulated, jointed; furnished with joints or *articulations*, where it separates or inclines to do so. *Articulated leaves*, 57.

Artificial Classification, 181.

Ascending (stems, &c.), 39; (seeds or ovules) 110.

Ascidium, a pitcher-shaped body, like leaves of *Sarracenia*.

Ascus (*osci*), a sac, the spore-case of Lichens and some Fungi.

Aspergilliform, shaped like the brush used to sprinkle holy water; as the stigmas of many Grasses.

Asperous, rough to touch.

Assimilation, 144, 147.

Assurgent, same as ascending, 39.

Atropous or *Atropal* (ovules), same as orthotropous.

Aurantiaceous, orange-colored.

Aureous, golden.

Auriculate, furnished with *auricles* or ear-like appendages, 53.

Autogamy, self-fertilization, 115.

Awl-shaped, sharp-pointed from a broader base, 61.

Awn, the bristle or beard of Barley, Oats, &c.; or any similar appendage.

Awned or *Awn-pointed*, furnished with an awn or long bristle-shaped tip, 54.

Axil, the angle on the upper side between a leaf and the stem, 13.

Axile, belonging to the axis, or occupying the axis.

Axillary (buds, &c.), occurring in an axil, 27.

Axis, the central line of any body; the organ round which others are attached; the root and stem. *Ascending* and *Descending Axis*, 38.

Baccate, berried, berry-like, of a pulpy-nature like a berry (*bacca*).

Badius, chestnut-colored.

Banner, see *Standard*, 92.

Barbate, bearded; bearing tufts, spots, or lines of hairs.

Barbed, furnished with a *barb* or double hook; as the apex of the bristle on the fruit of *Echinosperrum* (Stickseed), &c.

Barbellate, said of the bristles of the pappus of some Compositæ when beset with short, stiff hairs, longer than when denticulate, but shorter than when plumose.

Barbellulate, diminutive of *barbellate*.

Bark, the covering of a stem outside of the wood, 138, 140.

Basal, belonging or attached to the

Base, that extremity of any organ by which it is attached to its support.

Basifixed, attached by its base.

Bast, *Bast-fibres*, 134.

Beaked, ending in a prolonged narrow tip.

Bearded, see *barbate*. *Beard* is sometimes used for awn, more commonly for long or stiff hairs of any sort.

Bell-shaped, of the shape of a bell, as the corolla of *Harebell*, 90.

Berry, a fruit pulpy or juicy throughout, as a grape, 119.

Bi- (or *Bis*), in compound words, twice; as

Biarticulate, twice-jointed, or two-jointed; separating into two pieces.

Biauriculate, having two ears, as the leaf in fig. 126.

Bicallose, having two callosities or harder spots.

Bicarinatè, two-keeled.

Bicipital (*Biceps*), two-headed; dividing into two parts.

- Biconjugate*, twice paired, as when a petiole forks twice.
- Bidentate*, having two teeth (not twice or doubly dentate).
- Biennial*, of two years' continuance; springing from the seed one season, flowering and dying the next, 38.
- Bifurious*, two-ranked; arranged in two rows.
- Bifid*, two-cleft to about the middle.
- Bifoliolate*, a compound leaf of two leaflets, 59.
- Bifurcate*, twice forked; or more commonly, forked into two branches.
- Bijugate*, bearing two pairs (of leaflets, &c.).
- Bilabiate*, two-lipped, as the corolla of *Labiata*.
- Bilamellate*, of two plates (*lamellæ*), as the stigma of *Mimulus*.
- Bilobed*, the same as two-lobed.
- Bilocellate*, when a cell is divided into two *locelli*.
- Bilocular*, two-celled; as most anthers, the pod of Foxglove, &c.
- Binary*, in twos.
- Binate*, in couples, two together. *Bipartite*, the Latin form of two-parted.
- Binodal*, of two nodes.
- Binomial*, of two words, as the name of genus and species taken together, 180.
- Bipalmate*, twice palmately divided.
- Biparous*, bearing two.
- Bipinnate* (leaf), twice pinnate, 58. *Bipinnatifid*, twice pinnatifid, 57.
- Bipinnatisect*, twice pinnately divided.
- Biplicate*, twice folded together.
- Biserial*, or *Biseriate*, occupying two rows, one within the other.
- Biserrate*, doubly serrate, as when the teeth of a leaf are themselves serrate.
- Bisexual*, having both stamens and pistil.
- Biternate*, twice ternate; i. e. principal divisions three, each bearing three leaflets, 59.
- Bladdery*, thin and inflated.
- Blade* of a leaf, its expanded portion, 49.
- Bloom*, the whitish powder on some fruits, leaves, &c.
- Boat-shaped*, concave within and keeled without, in shape like a small boat.
- Border* of corolla, &c., 89.
- Brachiate*, with opposite branches at right angles to each other.
- Brachy-*, short, as *Brachycarpous*, short-fluted, &c.
- Bract* (*Bractea*), the leaf of an inflorescence. Specially, the bract is the small leaf or scale from the axil of which a flower or its pedicel proceeds, 73.
- Bracteate*, furnished with bracts.
- Bracteolate*, furnished with bractlets.
- Bracteose*, with numerous or conspicuous bracts.
- Bractlet* (*Bracteola*), or *Bracteole*, is a bract seated on the pedicel or flower-stalk, 73.
- Branch*, *Branching*, 27.
- Breathing-pores*, 144.
- Bristles*, stiff, sharp hairs, or any very slender bodies of similar appearance.
- Bristly*, beset with bristles. *Bristle-pointed*, 54.
- Brunneous*, brown.
- Brush-shaped*, see *aspergilliform*.
- Bryology*, that part of botany which relates to Mosses.
- Bryophyta*, *Bryophytes*, 163.
- Bud*, a branch in its earliest or undeveloped state, 27. *Bud-scales*, 63.
- Bulb*, a leaf-bud with fleshy scales, usually subterranean, 46.
- Bulbils*, diminutive bulbs.
- Bulbiferous*, bearing or producing bulbs. *Bulbose* or *bulbous*, bulb-like in shape, &c.
- Bulblets*, small bulbs, borne above ground, 46.
- Bulb-scales*, 46.
- Bullate*, appearing as if blistered or bladdery (from *bulla*, a bubble).
- Byssaceous*, composed of fine flax-like threads.

- Caducous*, dropping off very early, compared with other parts; as the calyx in the Poppy, falling when the flower opens.
- Cæruleous*, blue. *Cærulescent*, becoming bluish.
- Cæspitose*, or *Cespitose*, growing in turf-like patches or tufts.
- Calathiform*, cup-shaped.
- Calcarate*, furnished with a spur (*calcar*), 86, 87.
- Calceolate* or *Calceiform*, slipper-shaped, like one petal of the Lady's Slipper.
- Callose*, hardened; or furnished with callosities or thickened spots.
- Calvous*, bald or naked of hairs.
- Calyciflorus*, when petals and stamens are adnate to calyx.
- Calycine*, belonging to the calyx.
- Calyculate*, furnished with an outer accessory calyx (*calyculus*) or set of bracts looking like a calyx, as in true Pinks.
- Calyptra*, the hood or veil of the capsule of a Moss, 163.
- Calyptrate*, having a calyptra.
- Calyptroform*, shaped like a calyptra or candle-extinguisher.
- Calyx*, the outer set of the floral envelopes or leaves of the flower, 14, 79.
- Cambium*, *Cambium-layer*, 140.
- Campanulate*, bell-shaped, 90.
- Campylotropous*, or *Campylotropal*, curved ovules and seeds, 111. *Campylospermous*, applied to fruits of Umbelliferae when the seed is curved in at the edges, forming a groove down the inner face; as in Sweet Cicely.
- Canaliculate*, channelled, or with a deep longitudinal groove.
- Cancellate*, latticed, resembling lattice-work.
- Candidus*, Latin for pure white.
- Canescent*, grayish-white; hoary, usually because the surface is covered with fine white hairs. *Incanous* is whiter still.
- Canous*, whitened with pubescence; see *incanous*.
- Capillaceous*, *Capillary*, hair-like in shape; as fine as hair or slender bristles.
- Capitate*, having a globular apex, like the head on a pin.
- Capitellate*, diminutive of capitate.
- Capitulum*, a close rounded dense cluster or *head* of sessile flowers, 74.
- Capreolate*, bearing tendrils (from *capreolus*, a tendril).
- Capsule*, a dry dehiscent seed-vessel of a compound pistil, 122.
- Capsular*, relating to, or like a capsule.
- Capture of insects*, 154.
- Carina*, a keel; the two anterior petals of a papilionaceous flower, 92.
- Carinate*, keeled, furnished with a sharp ridge or projection on the lower side.
- Cariopsis*, or *Caryopsis*, the one-seeded fruit or grain of Grasses, 121.
- Carnæous*, flesh-colored; pale red. *Carnose*, fleshy in texture.
- Carpel*, or *Carpidium*, a simple pistil or a pistil-leaf, 106.
- Carpellary*, pertaining to a carpel.
- Carpology*, that department of botany which relates to fruits.
- Carpophore*, the stalk or support of a pistil extending between its carpels, 113.
- Carpus*, Greek for fruit.
- Cartilaginous*, or *Cartilagineous*, firm and tough in texture, like cartilage.
- Caruncle*, an excrescence at the scar of some seeds, 126.
- Carunculate*, furnished with a caruncle.
- Caryophyllaceous*, pink-like: applied to a corolla of 5 long-clawed petals.
- Cassideous*, helmet-shaped.
- Cassus*, empty and sterile.
- Catenate*, or *Catenulate*, end to end &c. in a chain.
- Catkin*, see *Ament*, 75.
- Caudate*, tailed, or tail-pointed.
- Caudex*, a sort of trunk, such as that of Palms; an upright rootstock, 39, 44.
- Caudicle*, the stalk of a pollen-mass, &c.
- Caulescent*, having an obvious stem, 36.

- Caulicle*, a little stem, or rudimentary stem (of a seedling), 11, 127.
Cauline, of or belonging to a stem, 36. *Caulis*, Latin name of stem.
Caulocarpic, equivalent to perennial.
Caulome, the cauline parts of a plant.
Cell (diminutive, *Cellule*), the cavity of an anther, ovary, &c.; one of the anatomical elements, 131.
Cellular Cryptogams, 162. *Cellular tissue*, 131.
Cellulose, 131. *Cell-walls*, 130.
Centrifugal (inflorescence), produced or expanding in succession from the centre outwards, 77.
Centripetal, the opposite of centrifugal, 74.
Cephalæ, Greek for head. In compounds, *Monocephalous*, with one head, *Microcephalous*, small-headed, &c.
Cereal, belonging to corn, or corn-plants.
Cernuous, nodding; the summit more or less inclining.
Chæta, Greek for bristle.
Chaff, small membranous scales or bracts on the receptacle of *Compositæ*; the glumes, &c., of grasses.
Chaffy, furnished with chaff, or of the texture of chaff.
Chalaza, that part of the ovule where all the parts grow together, 110, 126.
Channelled, hollowed out like a gutter; same as *canaliculate*.
Character, a phrase expressing the essential marks of a species, genus, &c., 181.
Chartaceous, of the texture of paper or parchment.
Chloros, Greek for green, whence *Chloranthous*, green-flowered; *Chlorocarpous*, green-fruited, &c.
Chlorophyll, leaf green, 136.
Chlorosis, a condition in which naturally colored parts turn green.
Choripetalous, same as polypetalous.
Chorisis, separation of the normally united parts, or where two or more parts take the place of one.
Chromule, coloring matter in plants, especially when not green, or when liquid.
Chrysos, Greek for golden yellow, whence *Chrysanthous*, yellow-flowered, &c.
Cicatrix, the scar left by the fall of a leaf or other organ.
Ciliate, beset on the margin with a fringe of *cilia*, i. e. of hairs or bristles, like the eyelashes fringing the eyelids, whence the name.
Cinereous, or *Cineraceous*, ash-grayish; of the color of ashes.
Circinate, rolled inwards from the top, 72.
Circumscissile, or *Circumcissile*, divided by a circular line round the sides, as the pods of Purslane, Plantain, &c., 124.
Circumscription, general outline.
Cirriferous, or *Cirrhose*, furnished with a tendril (Latin, *Cirrhus*); as the Grape vine. *Cirrhose* also means resembling or coiling like tendrils, as the leaf-stalks of Virgin's-bower. More properly *Cirrus* and *Cirrosc*.
Citreo, lemon-yellow.
Clados, Greek for branch. *Cladophylla*, 64.
Class, 178, 183.
Classification, 175, 183.
Clathrate, latticed; same as *cancellate*.
Clavate, club-shaped; slender below and thickened upwards.
Clavellate, diminutive of clavate.
Claviculate, having *Claviculæ*, or little tendrils or hooks.
Claw, the narrow or stalk-like base of some petals, as of Pinks, 91.
Cleistogamous (*Cleistogamy*), fertilized in closed bud, 115.
Cleft, cut into lobes, 55.
Close fertilization, 115.
Climbing, rising by clinging to other objects, 39, 151.
Club-shaped, see *clavate*.
Clustered, leaves, flowers, &c., aggregated or collected into a bunch.

- Clypeate*, buckler-shaped.
- Coadunate*, same as *connate*, i. e. united.
- Coalescent*, growing together. *Coalescence*, 88.
- Coarctate*, contracted or brought close together.
- Coated*, having an integument, or covered in layers. *Coated bulb*, 46.
- Cobwebby*, same as *arachnoid*; bearing hairs like cobwebs or gossamer.
- Coccineous*, scarlet-red.
- Coccus* (plural *cocci*), anciently a berry; now mostly used to denote the separable carpels or nutlets of a dry fruit.
- Cochleariform*, spoon-shaped.
- Cochleate*, coiled or shaped like a snail-shell.
- Celospermous*, applied to those fruits of *Umbelliferae* which have the seed hollowed on the inner face, by incurving of top and bottom; as in *Coriander*.
- Coherent*, usually the same as *connate*.
- Cohort*, name sometimes used for groups between order and class, 178.
- Coleorhiza*, a root-sheath.
- Collateral*, side by side.
- Collective fruits*, 118.
- Collum* or *Collar*, the neck or junction of stem and root.
- Colored*, parts of a plant which are other-colored than green.
- Columella*, the axis to which the carpels of a compound pistil are often attached, as in *Geranium* (112), or which is left when a pod opens, as in *Azalea*.
- Column*, the united stamens, as in *Mallow*, or the stamens and pistils united into one body, as in the *Orchis* family.
- Columnar*, shaped like a column or pillar.
- Coma*, a tuft of any sort (literally, a head of hair), 125.
- Comose*, tufted; bearing a tuft of hairs, as the seeds of *Milkweed*, 126.
- Commissure*, the line of junction of two carpels, as in the fruit of *Umbelliferae*.
- Complanate*, flattened.
- Compound leaf*, 54, 57. *Compound pistil*, 107. *Compound umbel*, 75, &c.
- Complete* (flower), 81.
- Complicate*, folded upon itself.
- Compressed*, flattened on opposite sides.
- Conceptacle*, 168.
- Concinnous*, neat.
- Concolor*, all of one color.
- Conchiform*, shell- or half-shell-shaped.
- Conduplicate*, folded upon itself lengthwise, 71.
- Cone*, the fruit of the *Pine* family, 124. *Coniferous*, cone-bearing.
- Confertus*, much crowded.
- Conferruminate*, stuck together, as the cotyledons in a horse-chestnut.
- Confluent*, blended together; or the same as *coherent*.
- Conformed*, similar to another thing it is associated with or compared to; or closely fitted to it, as the skin to the kernel of a seed.
- Congested*, *Conglomerate*, crowded together.
- Conglomerate*, crowded into a glomerule.
- Conjugate*, coupled; in single pairs. *Conjugation*, 170.
- Connate*, united or grown together from the first formation, 96.
- Connate-perfoliate*, when a pair of leaves are connate round a stem, 60.
- Connective*, *Connecticum*, the part of the anther connecting its two cells, 101.
- Connivent*, converging, or brought close together.
- Consolidation* (floral), 94.
- Consolidated* forms of vegetation, 47.
- Contents* of cells, 136.
- Continuous*, the reverse of interrupted or articulated.
- Contorted*, twisted together. *Contorted aestivation*, same as *convolute*, 97.
- Contortuplicate*, twisted back upon itself.
- Contracted*, either narrowed or shortened.

Contrary, turned in opposite direction to the ordinary.

Convolute, rolled up lengthwise, as the leaves of the Plum in vernation, 72. In aestivation, same as *contorted*, 97.

Cordate, heart-shaped, 53.

Coriaceous, resembling leather in texture.

Corky, of the texture of cork. *Corky layer* of bark, 141.

Corm, a solid bulb, like that of Crocus, 45.

Corneous, of the consistence or appearance of horn.

Corniculate, furnished with a small horn or spur.

Coronate, bearing a horn-like projection or appendage.

Corolla, the leaves of the flower within the calyx, 14, 79.

Corollaceous, *Corolline*, like or belonging to a corolla.

Corona, a coronet or crown; an appendage at the top of the claw of some petals, 91.

Coronate, crowned; furnished with a crown.

Cortex, bark. *Cortical*, belonging to the bark (*cortex*).

Corticate, coated with bark or bark-like covering.

Corymb, a flat or convex indeterminate flower-cluster, 74.

Corymbiferous, bearing corymbs.

Corymbose, in corymbs, approaching the form of a corymb, or branched in that way.

Costa, a rib; the midrib of a leaf, &c. *Costate*, ribbed.

Cotyledons, the proper leaves of the embryo, 11, 127.

Crateriform, goblet-shaped or deep saucer-shaped.

Creeping (stems), growing flat on or beneath the ground and rooting, 39.

Cremocarp, a half-fruit, or one of the two carpels of Umbelliferæ, 121.

Crenate, or *Crenelled*, the edge scalloped into rounded teeth, 55.

Crenulate, minutely or slightly crenate.

Crested, or *Cristate*, bearing any elevated appendage like a crest.

Cretaceous, chalky or chalk-like.

Cribose, or *cribriiform*, pierced like a sieve with small apertures.

Crinite, bearing long hairs.

Crispate, curled or crispy.

Croceous, saffron-color, deep reddish-yellow.

Cross-breeds, the progeny of interbred varieties, 176.

Cross fertilization, 115.

Crown, see *corona*. *Crowned*, see *coronate*.

Cruciate, or *Cruciform*, cross-shaped. *Cruciform Corolla*, 86.

Crustaceous, hard and brittle in texture; crust-like.

Cryptogamous Plants, *Cryptogams*, 10, 156.

Cryptos, concealed, as *Cryptopetalous*, with concealed petals, &c.

Crystals in plants, 137.

Cucullate, hooded, or hood-shaped, rolled up like a cornet of paper, or a hood (*cucullus*), as the spathe of Indian Turnip, 75.

Culm, a straw; the stem of Grasses and Sedges, 39.

Cultrate, shaped like a trowel or broad knife.

Cuneate, *Cuneiform*, wedge-shaped, 53.

Cup-shaped, same as *cyathiform* or near it.

Cupule, a little cup; the cup to the acorn of the Oak, 122.

Cupular, or *Cupulate*, provided with a cupule.

Cupuliferous, cupule-bearing.

Curviveined, with curved ribs or veins.

Curviserial, in oblique or spiral ranks.

Cushion, the enlargement at the insertion or base of a petiole.

Cuspidate, tipped with a sharp and stiff point or *cusp*, 54.

Cut, same as *incised*, or applied generally to any sharp and deep division, 55.

Cuticle, the skin of plants, or more strictly its external pellicle.

Cyaneous, bright blue.

Cyathiform, in the shape of a cup, or particularly of a wine-glass.

Cycle, one complete turn of a spire, or a circle, 70.

Cyclical, rolled up circularly, or coiled into a complete circle.

Cyclosis, circulation in closed cells, 149.

Cylindrical, approaching to the *Cylindrical* form, terete and not tapering.

Cymbæform, or *Cymbiform*, same as boat-shaped.

Cyme, a cluster of centrifugal inflorescence, 77.

Cymose, furnished with cymes, or like a cyme.

Cymule, a partial or diminutive cyme, 77.

Deca- (in words of Greek derivation), ten; as

Decagynous, with 10 pistils or styles, *Decamerous*, of 10 parts, *Decandrous*, with 10 stamens, &c.

Deciduous, falling off, or subject to fall; said of leaves which fall in autumn, and of a calyx and corolla which fall before the fruit forms.

Declinate, *declined*, turned to one side, or downwards.

Decomound, several times compounded or divided, 59.

Decumbent, reclined on the ground, the summit tending to rise, 39.

Decurrent (leaves), prolonged on the stem beneath the insertion, as in Thistles.

Decussate, arranged in pairs which successively cross each other, 71.

Deduplication, same as choris.

Definite, when of a uniform number, and not above twelve or so.

Definite Inflorescence, 72.

Deflexed, bent downwards.

Deflorate, past the flowering state, as an anther after it has discharged its pollen.

Dehiscence, the regular splitting open of capsule or anther, 103, 119.

Dehiscent, opening by regular dehiscence, 119, 123.

Deliquescent, branching off so that the stem is lost in the branches, 32.

Deltoid, of a triangular shape, like the Greek capital Δ.

Demersed, growing below the surface of water.

Dendroid, *Dendritic*, tree-like in form or appearance.

Dendron, Greek for tree.

Deni, ten together.

Dens, Latin for tooth.

Dentate, toothed, 55. *Denticulate*, furnished with denticulations, or little teeth.

Depauperate, impoverished or starved, and so below the natural size.

Depressed, flattened or as if pressed down from above.

Derma, Greek for skin.

Descending, tending gradually downwards. *Descending axis*, the root.

Desmos, Greek for things connected or bound together.

Determinate Inflorescence, 72.

Dextrorse, turned to the right hand.

Di- *Dis* (in Greek compounds) two, as

Diadelphous (stamens), united by their filaments in two sets, 99.

Diagnosis, a short distinguishing character or descriptive phrase.

Dialypetalous, same as polypetalous.

Diandrous, having two stamens, &c.

Diaphanous, transparent or translucent.

Dicarpellary, of two carpels.

Dichlamydeous (flower), having both calyx and corolla.

Dichogamous, *Dichogamy*, 116.

Dichotomous, two-forked.

Diclinous, having the stamens in one flower, the pistils in another, 85.

Dicocous (fruit), splitting into two cocci or closed carpels.

Dicotyls, 23.

Dicotyledonous (embryo), having a pair of cotyledons, 23. *Dicotyledonous Plants*, 23
182.

Didymous, twin.

Didynamous (stamens), having four stamens in two pairs, 100.

Diffuse, spreading widely and irregularly.

- Digitate* (fingered), where the leaflets of a compound leaf are all borne on the apex of the petiole, 58.
- Digynous* (flower), having two pistils or styles, 105.
- Dimerous*, made up of two parts, or its organs in twos.
- Dimidiate*, halved; as where a leaf or leaflet has only one side developed.
- Dimorphism*, 117. *Dimorphous*, *Dimorphic*, of two forms, 117.
- Dioicous*, or *Dioicous*, with stamens and pistils on different plants, 85.
- Dipetalous*, of two petals. *Diphyllous*, two-leaved. *Dipterous*, two-winged.
- Diplo-*, Greek for double, as *Diplostemonous*, with two sets of stamens.
- Disciform* or *Disk-shaped*, flat and circular, like a disk or quoit.
- Discoidal*, or *Discoid*, belonging to or like a disk.
- Discolor*, of two different colors or hues.
- Discrete*, separate, opposite of concrete.
- Disepalous*, of two sepals.
- Disk*, the face of any flat body; the central part of a head of flowers, like the Sun-flower, or Coreopsis, as opposed to the *ray* or margin; a fleshy expansion of the receptacle of a flower, 113.
- Disk-flowers*, those of the disk in Compositæ.
- Dissected*, cut deeply into many lobes or divisions.
- Dissepiments*, the partitions of a compound ovary or a fruit, 108.
- Dissilient*, bursting in pieces.
- Distichous*, two-ranked.
- Distinct*, uncombined with each other, 95.
- Ditheous*, of two thecæ or anther-cells.
- Divaricate*, straddling; very widely divergent.
- Divided* (leaves, &c.), cut into divisions down to the base or midrib, 55.
- Dodeca*, Greek for twelve; as *Dodecagynous*, with twelve pistils or styles, *Dodecandrous*, with twelve stamens.
- Dodrums*, span-long.
- Dolabriform*, axe-shaped.
- Dorsal*, pertaining to the back (*dorsum*) of an organ. *Dorsal Suture*, 106.
- Dotted Ducts*, 148.
- Double Flowers*, where the petals are multiplied unduly, 79.
- Downy*, clothed with a coat of soft and short hairs.
- Drupeaceous*, like or pertaining to a drupe.
- Drupe*, a stone-fruit, 120. *Drupelet* or *Drupel*, a little drupe.
- Ducts*, the so-called vessels of plants, 134.
- Dumose*, bushy, or relating to bushes.
- Duramen*, the heart-wood, 142.
- Dwarf*, remarkably low in stature.
- E-*, as a prefix of Latin compound words, means destitute of; as *ecostate*, without a rib or midrib; *exalbuminous*, without albumen, &c.
- Eared*, see *auriculate*, 53.
- Ebracteate*, destitute of bracts. *Ebracteolate*, destitute of bractlets.
- Eburneous*, ivory-white.
- Echinate*, armed with prickles (like a hedgehog). *Echinulate*, a diminutive of it.
- Edentate*, toothless.
- Effete*, past bearing, &c.; said of anthers which have discharged their pollen.
- Effuse*, very loosely branched and spreading.
- Eglandulose*, destitute of glands.
- Elaters*, threads mixed with the spores of Liverworts, 165.
- Ellipsoidal*, approaching an elliptical figure.
- Elliptical*, oval or oblong, with the ends regularly rounded, 52.
- Emarginate*, notched at the summit, 54.
- Embryo*, the rudimentary plantlet in a seed, 11, 127.
- Embryonal*, belonging or relating to the embryo.
- Embryo-sac*, 117.

Emersed, raised out of water.

Endecagynous, with eleven pistils or styles. *Endecandrous*, with eleven stamens.

Endemic, peculiar to the country geographically.

Endocarp, the inner layer of a pericarp or fruit, 120.

Endochrome, the coloring matter of Algæ and the like.

Endogenous Stems, 138. *Endogenous plants*, an old name for monocotyledons.

Endopleura, inner seed-coat.

Endorhizal, radicle or root sheathed in germination.

Endosperm, the albumen of a seed, 21.

Endostome, the orifice in the inner coat of an ovule.

Ennea-, nine. *Enneagynous*, with nine petals or styles. *Enneandrous*, nine-stamened.

Ensate, *Ensiform*, sword-shaped.

Entire, the margins not at all toothed, notched, or divided, but even, 55.

Entomophilous, said of flowers frequented and fertilized by insects, 113.

Ephemeral, lasting for a day or less, as the corolla of Purslane, &c.

Epi-, Greek for upon.

Epicalyx, such an involucre as that of Malvaceæ.

Epicarp, the outermost layer of a fruit, 120.

Epidermal, relating to the *Epidermis*, or skin of a plant, 50, 141, 143.

Epigæous, growing on the earth, or close to the ground.

Epigynous, upon the ovary, 95, 99.

Epipetalous, borne on the petals or the corolla, 99.

Epiphyllous, borne on a leaf.

Epiphyte, a plant growing on another plant, but not nourished by it, 36.

Epiphytic or *Epiphytal*, relating to *Epiphytes*.

Epipterus, winged at top.

Episperm, the skin or coat of a seed, especially the outer coat.

Equal, alike in number or length.

Equally pinnate, same as abruptly pinnate, 57.

Équitant (riding straddle), 60.

Erion, Greek for wool. *Erianthous*, woolly-flowered. *Eriophorous*, wool-bearing, &c.

Erode, eroded, as if gnawed.

Erostrate, not beaked.

Erythros, Greek for red. *Erythrocarpous*, red-fruited, &c.

Essential Organs of the flower, 80.

Estivation, see *æstivation*.

Etiolated, blanched by excluding the light, as the stalks of Celery.

Eu, Greek prefix, meaning very, or much.

Evergreen, holding the leaves over winter and until new ones appear, or longer.

Ex, Latin prefix; privative in place of "e" when next letter is a vowel. So *Exalate*, wingless; *Exalbuminous* (seed), without albumen, 21.

Excurrent, running out, as when a midrib projects beyond the apex of a leaf, or a trunk is continued to the very top of a tree, 32.

Exiguous, puny.

Exilis, lank or meagre.

Eximius, distinguished for size or beauty.

Exo-, in Greek compounds, outward, as in

Exocarp, outer layer of a pericarp, 120.

Exogenous, outward growing. *Exogenous stems*, 139.

Exorhizal, radicle in germination not sheathed.

Exostome, the orifice in the outer coat of the ovule.

Explanate, spread or flattened out.

Exserted, protruding out of, as the stamens out of the corolla.

Exstipulate, destitute of stipules.

Extine, outer coat of a pollen-grain.

Extra-axillary, said of a branch or bud somewhat out of the axil, 31.

Extrorse, turned outwards; the anther is extrorse when fastened to the filament on the side next the pistil, and opening on the outer side, 101.

- Falcate*, scythe-shaped; a flat body curved; its edges parallel.
- False Racemes*, 78.
- Family*, in botany same as Order, 177.
- Farina*, meal or starchy matter, 136.
- Farinaceous*, mealy in texture. *Farinose*, covered with a mealy powder.
- Fasciate*, banded; also applied to monstrous stems which grow flat.
- Fascicle*, a close cluster, 77.
- Fascicled*, *Fasciculated*, growing in a bundle or tuft, as the leaves of Larch, 68, and roots of Peony, 35.
- Fastigate*, close, parallel, and upright, as the branches of Lombardy Poplar.
- Fauz* (plural, *fauces*), the throat of a calyx, corolla, &c., 89.
- Faveolate*, *Favose*, honeycombed; same as *alveolate*.
- Feather-veined*, with veins of a leaf all springing from the sides of a midrib, 51.
- Fecula* or *Fæcula*, starch, 136.
- Female flower* or *plant*, one bearing pistils only.
- Fenestrate*, pierced with one or more large holes, like windows.
- Ferruginous*, or *Ferruginous*, resembling iron-rust; red-grayish.
- Fertile*, fruit-bearing, or capable of it; also said of anthers producing good pollen.
- Fertilization*, the process by which pollen causes the embryo to be formed, 114.
- Fibre* (woody), 133. *Fibrous*, containing much fibre, or composed of fibres.
- Fibrillose*, formed of small fibres, or *Fibrillæ*.
- Fibro-vascular* bundle or tissue, formed of fibres and vessels.
- Fiddle-shaped*, obovate with a deep recess on each side.
- Fidus*, Latin suffix for cleft, as *Bifid*, two-cleft.
- Filament*, the stalk of a stamen, 14, 80, 101; also any slender thread-shaped body.
- Filamentose*, or *Filamentous*, bearing or formed of slender threads.
- Filiform*, thread-shaped; long, slender, and cylindrical.
- Fimbriate*, fringed; furnished with fringes (*fimbriæ*).
- Fimbrillate*, *Fimbrilliferous*, bearing small *fimbriæ*, i. e. *fimbrillæ*.
- Fissiparous*, multiplying by division of one body into two.
- Fissus*, Latin for split or divided.
- Fistular*, or *Fistulose*, hollow and cylindrical, as the leaves of the Onion.
- Flabelliform*, or *Flabellate*, fan-shaped.
- Flagellate*, or *Flagelliform*, long, narrow, and flexible, like the thong of a whip; or like the runners (*flagellæ*) of the Strawberry.
- Flavescent*, yellowish, or turning yellow.
- Flavus*, Latin for yellow.
- Fleshy*, composed of firm pulp or flesh.
- Flexuose*, or *Flexuous*, bending in opposite directions, in a zigzag way.
- Floating*, swimming on the surface of water.
- Floccose*, composed of or bearing tufts of woolly or long and soft hairs.
- Flora* (the goddess of flowers). the plants of a country or district, taken together, or a work systematically describing them, 9.
- Floral Envelopes*, or *Flower-leaves*, 79.
- Floret*, a diminutive flower, one of a mass or cluster.
- Floribund*, abundantly floriferous.
- Florula*, the flora of a small district.
- Flos*, *floris*, Latin for flower.
- Flosculus*, diminutive, same as floret.
- Flower*, the whole organs of reproduction of Phænogamous plants, 14, 72.
- Flower-bud*, an unopened flower.
- Flowering Plants*, 10, 156. *Flowerless Plants*, 10, 156.
- Fly-trap leaves*, 65.
- Fluitans*, Latin for floating. *Fluvial*, belonging to a river or stream.
- Foliaceous*, belonging to, or of the texture or nature of, a leaf (*folium*).
- Foliate*, provided with leaves. Latin prefixes denote the number of leaves, as *bifoliate*, *trifoliate*, &c. *Foliose*, leafy; abounding in leaves.
- Foliolate*, relating to or bearing leaflets (*foliola*); *trifoliolate*, with three leaflets, &c.

Folium (plural, *folia*), Latin for leaf.

Follicle, a simple pod, opening down the inner suture, 122.

Follicular, resembling or belonging to a follicle.

Food of Plants, 144.

Foot-stalk, either petiole or peduncle, 49.

Foramen, a hole or orifice, as that of the ovule, 110.

Foraminose, *Foraminulose*, pierced with holes.

Forked, branched in two or three or more.

Fornicate, bearing fornicies.

Fornix, little arched scales in the throat of some corollas, as of Comfrey.

Foveate, deeply pitted. *Foveolate*, diminutive of *foveate*.

Free, not united with any other parts of a different sort, 95.

Fringed, the margin beset with slender appendages, bristles, &c.

Fronde, what answers to leaves in Ferns, &c., 157; or to the stem and leaves fused into one, as in Liverwort.

Frondescence, the bursting into leaf.

Frondose, frond-bearing; like a frond, or sometimes used for leafy.

Fructification, the state or result of fruiting.

Fructus, Latin for fruit.

Fruit, the matured ovary and all it contains or is connected with, 117.

Fruit-dots in Ferns: see *Sorus*.

Frutulose, consisting of a chain of similar pieces, or *Frustules*.

Frutescent, somewhat shrubby; becoming a shrub (*Frutex*), 39.

Fruticulose, like a small shrub, or *Fruticulus*. *Fruticose*, shrubby, 39.

Fugacious, soon falling off or perishing.

Fulcrate, having accessory organs or *fulcra*, i. e. props.

Fulvous, tawny; dull yellow with gray.

Fungus, *Fungi*, 172.

Funicle, *Funiculus*, the stalk of a seed or ovule, 110.

Funnel-form, or *funnel-shaped*, expanding gradually upwards into an open mouth, like a funnel or tunnel, 90.

Furcate, forked.

Furfuraceous, covered with br  n-like fine scurf.

Furrowed, marked by longitudinal channels or grooves.

Fuscous, deep gray-brown.

Fusiform, spindle-shaped, 36.

Galbulus, the fleshy or at length woody cone of Juniper and Cypress.

Galea, a helmet-shaped body, as the upper sepal of the Monkshood, 87.

Galeate, shaped like a helmet.

Gamopetalous, of united petals, 89.

Gamophyllous, formed of united leaves. *Gamosepalous*, formed of united sepals, 89.

Geminate, twin; in pairs.

Gemma, Latin for a bud.

Gemmation, the state of budding; budding growth.

Gemmule, a small bud; the plumule, 6.

Genera, plural of genus.

Geniculate, bent abruptly, like a knee (*genu*), as many stems.

Generic Names, 179.

Genus, a kind of a rank above species, 177.

Germ, a growing point; a young bud; sometimes the same as *embryo*, 127.

Germen, the old name for ovary.

Germination, the development of a plantlet from the seed, 12.

Gerontog  ous, inhabiting the Old World.

Gibbous, more tumid at one place or on one side than the other

Gilvous, dirty reddish-yellow.

Glabrate, becoming glabrous with age, or almost glabrous.

Glabrous, smooth, in the sense of having no hairs, bristles, or other pubescence.

Gladiate, sword-shaped, as the leaves of Iris.

Glands, small cellular organs which secrete oily or aromatic or other products; they are sometimes sunk in the leaves or rind, as in the Orange, Prickly Ash, &c.; sometimes on the surface as small projections; sometimes raised on hairs or bristles (*glandular hairs*, &c.), as in the Sweetbrier and Sundew. The name is also given to any small swellings, &c., whether they secrete anything or not; so that the word is loosely used.

Glandular, *Glandulose*, furnished with glands, or gland-like.

Glans (*Gland*), the acorn or mast of Oak and similar fruits.

Glareous, growing in gravel.

Glaucouscent, slightly glaucous, or bluish-gray.

Glaucous, covered with a bloom, viz. with a fine white powder of wax that rubs off, like that on a fresh plum, or a cabbage-leaf.

Globose, spherical in form, or nearly so. *Globular*, nearly globose.

Glochidiate, or *Glochideous*, (bristles) barbed; tipped with barbs, or with a double hooked point.

Glomerate, closely aggregated into a dense cluster.

Glomerule, a dense head-like cluster, 77.

Glossology, the department of botany in which technical terms are explained.

Glumaceous, glume-like, or glume-bearing.

Glume; Glumes are the husks or floral coverings of Grasses, or, particularly, the outer husks or bracts of each spikelet.

Glumelles, the inner husks of Grasses.

Gonophore, a stipe below stamens, 113.

Gossypine, cottony, flocculent.

Gracilis, Latin for slender.

Grain, see *Caryopsis*, 121.

Gramineous, grass-like.

Granular, composed of grains. *Granule*, a small grain.

Graveolent, heavy-scented.

Griseous, gray or bluish-gray.

Growth, 129.

Grumous, or *Grumose*, formed of coarse clustered grains.

Guttate, spotted, as if by drops of something colored.

Gymnos, Greek for naked, as

Gymnocarpous, naked-fruited. *Gymnospermous*, naked-seeded, 109.

Gymnospermous gynæcium, 109.

Gymnospermæ, or *Gymnospermous Plants*, 183.

Gynandrous, with stamens borne on, i. e. united with, the pistil, 99.

Gynæcium, a name for the pistils of a flower taken altogether, 105.

Gynobase, a depressed receptacle or support of the pistil or carpels, 114.

Gynophore, a stalk raising a pistil above the stamens, 113.

Gynostegium, a sheath around pistils, of whatever nature.

Gynostemium, name of the column in Orchids, &c., consisting of style and stigma with stamens combined.

Gyrate, coiled or moving circularly.

Gyrose, strongly bent to and fro.

Habit, the general aspect of a plant, or its mode of growth.

Habitat, the situation or country in which a plant grows in a wild state.

Hairs, hair-like growths on the surface of plants.

Hairy, beset with hairs, especially longish ones.

Halberd-shaped, see *hastate*, 53.

Halved, when appearing as if one half of the body were cut away.

Hamate, or *Humose*, hooked; the end of a slender body bent round.

Hamulose, bearing a small hook; a diminutive of the last.

Haplo-, in Greek compounds, single; as *Haplostemonous*, having only one series of stamens.

- Hastate*, or *Hastile*, shaped like a halberd; furnished with a spreading lobe on each side at the base, 53.
- Head*, capitulum, a form of inflorescence, 74.
- Heart-shaped*, of the shape of a heart as painted on cards, 53.
- Heart-wood*, the older or matured wood of exogenous trees, 142.
- Helicoid*, coiled like a *helix* or snail-shell, 77.
- Helmet*, the upper sepal of Monkshood is so called.
- Helvolous*, grayish-yellow.
- Hemi*- in compounds from the Greek, half; e. g. *Hemispherical*, &c.
- Hemicarp*, half-fruit, one carpel of an Umbelliferous plant, 121.
- Hemitropous* (ovule or seed), nearly same as *amphitropous*, 123.
- Hepta*- (in words of Greek origin), seven; as *Heptagynous*, with seven pistils or styles. *Heptamerous*, its parts in sevens. *Heptandrous*, having seven stamens
- Herb*, plant not woody, at least above ground.
- Herbaceous*, of the texture of an herb; not woody, 39.
- Herbarium*, the botanist's arranged collection of dried plants, 186.
- Herborization*, 184.
- Hermaphrodite* (flower), having stamens and pistils in the same blossom, 81.
- Hesperidium*, orange-fruit, a hard-rinded berry.
- Hetero*-, in Greek compounds, means of two or more sorts, as
- Heterocarpous*, bearing fruit of two kinds or shapes.
- Heterogamous*, bearing two or more sorts of flowers in one cluster.
- Heterogony*, *Heterogone*, or *Heterogonous*, with stamens and pistil reciprocally of two sorts, 116. *Heterostyled* is same.
- Heteromorphous*, of two or more shapes.
- Heterophyllous*, with two sorts of leaves.
- Heterotropous* (ovule), the same as *amphitropous*, 123.
- Hexa*- (in Greek compounds), six; as *Hexagonal*, six-angled. *Hexagynous*, with six pistils or styles. *Hexamerous*, its parts in sixes. *Hexandrous*, with six stamens. *Hexapterous*, six-winged
- Hibernaculum*, a winter bud.
- Hiemal*, relating to winter.
- Hilar*, belonging to the hilum.
- Hilum*, the scar of the seed; its place of attachment, 110, 126.
- Hippocrepiform*, horseshoe-shaped.
- Hirsute*, clothed with stiffish or beard-like hairs.
- Hirtellous*, minutely hirsute.
- Hispid*, bristly, beset with stiff hairs. *Hispidulus*, diminutive of hispid.
- Histology*, 9.
- Hoary*, grayish-white; see *canescent*, &c.
- Holosericeous*, all over sericeous or silky.
- Homo*-, in Greek compounds, all alike or of one sort.
- Homodromous*, running in one direction.
- Homogamous*, a head or cluster with flowers all of one kind.
- Homogeneous*, uniform in nature; all of one kind.
- Homogone*, or *Homogonous*, counterpart of *Heterogone* or *Homostyled*.
- Homologous*; of same type; thus petals and sepals are the homologues of leaves.
- Homomallous* (leaves, &c.), originating all round an axis, but all bent or curved to one side.
- Homorphous*, all of one shape.
- Homotropous* (embryo), curved with the seed; curved only one way.
- Hood*, same as *helmet* or *galea*. *Hooded*, hood-shaped; see *cucullate*.
- Hooked*, same as *hamate*.
- Horn*, a spur or some similar appendage. *Horny*, of the texture of horn.
- Hortensis*, pertaining to the garden.
- Hortus Siccus*, an herbarium, or collection of dried plants, 201.
- Humifuse*, *Humistrate*, spread over the surface of the ground.
- Humilis*, low in stature.

Hyaline, transparent, or partly so.

Hybrid, a cross-breed between two allied species, 176.

Hydrophytes, water-plants.

Hyemal, see *hiemal*.

Hymenium of a Mushroom, 172.

Hypanthium, a hollow flower-receptacle, such as that of Rose.

Hypo-, Greek prefix for under, or underneath.

Hypocotyle, or *Hypocotyl*, part of stem below the cotyledons, 11.

Hypocrateriform, properly *Hypocraterimorphous*, salver-shaped.

Hypogæan, or *Hypogæous*, produced under ground, 19.

Hypogynous, inserted under the pistil, 95, 99.

Hysteranthous, with the blossoms developed earlier than the leaves.

Icosandrous, having 20 (or 12 or more) stamens inserted on the calyx.

Imberbis, Latin for beardless.

Inbricate, *Imbricated*, *Imbricative*, overlapping one another, like tiles or shingles on a roof, as the bud-scales of Horse-chestnut and Hickory, 27. In æstivation, where some leaves of the calyx or corolla are overlapped on both sides by others, 98.

Immarginate, destitute of a rim or border.

Immersed, growing wholly under water.

Impari-pinnate, pinnate with a single leaflet at the apex, 57.

Imperfect flowers, wanting either stamens or pistils, 85.

Inæquilateral, unequal-sided, as the leaf of a Begonia.

Inane, empty, said of an anther which produces no pollen, &c.

Inappendiculate, not appendaged.

Incanous, *Incanescent*, hoary with soft white pubescence.

Incarnate, flesh-colored.

Incised, cut rather deeply and irregularly, 58.

Included, enclosed; when the part in question does not project beyond another.

Incomplete Flower, wanting calyx or corolla, 86.

Incrassated, thickened.

Incubous, with tip of one leaf lying flat over the base of the next above.

Incumbent, leaning or resting upon; the cotyledons are incumbent when the back of one of them lies against the radicle, 128; the anthers are incumbent when turned or looking inwards.

Incurved, gradually curving inwards.

Indefinite, not uniform in number, or too numerous to mention (over 12).

Indefinite or *Indeterminate Inflorescence*, 72.

Indehiscent, not splitting open; i. e. not dehiscent, 119.

Indigenous, native to the country.

Individuals, 175.

Indumentum, any hairy coating or pubescence.

Induplicate, with the edges turned inwards, 97.

Induviate, clothed with old and withered parts or *induviae*.

Indusium, the shield or covering of a fruit-dot of a Fern, 159.

Inermis, Latin for unarmed, not prickly.

Inferior, growing below some other organ, 96.

Infertile, not producing seed, or pollen, as the case may be.

Inflated, turgid and bladdery.

Inflexed, bent inwards.

Inflorescence, the arrangement of flowers on the stem, 72.

Infra-axillary, situated beneath the axil.

Infundibuliform or *Infundibular*, funnel-shaped, 90.

Innate (anther), attached by its base to the very apex of the filament, 101.

Innovation, a young shoot, or new growth.

Insertion, the place or the mode of attachment of an organ to its support, 95, 99.

Integer, entire, not lobed. *Integerrimus*, quite entire, not serrate.

Intercellular Passages or Spaces, 131, 143.

Interfoliaceous, between the leaves of a pair or whorl.

Internode, the part of a stem between two nodes, 13.

Interpetiolar, between petioles.

Interruptedly pinnate, pinnate with small leaflets intermixed with larger.

Intine, inner coat of a pollen grain.

Intrafoliaceous (stipules, &c.), placed between the leaf or petiole and the stem.

Introrse, turned or facing inwards; i. e. towards the axis of the flower, 101.

Intruse, as it were pushed inwards.

Inversed or Inverted, where the apex is in the direction opposite to that of the organ it is compared with.

Involucel, a partial or small involucre, 76.

Involucellate, furnished with an involucre. *Involucrate*, furnished with an involucre.

Involucre, a whorl or set of bracts around a flower, umbel, or head, &c., 74, 75.

Involute, in veneration, 72; rolled inwards from the edges, 97.

Irregular Flowers, 86, 91.

Isos, Greek for equal in number. *Isomerous*, the same number in the successive circles or sets. *Isostemonous*, the stamens equal in number to the sepals or petals.

Jointed, separate or separable at one or more places into pieces, 64, &c.

Jugum (plural *Juga*), Latin for a pair, as of leaflets, — thus *Unijugate*, of a single pair; *Bijugate*, of two pairs, &c.

Julaceus, like a catkin or *Julus*.

Keel, a projecting ridge on a surface, like the keel of a boat; the two anterior petals of a papilionaceous corolla, 92.

Keeled, furnished with a keel or sharp longitudinal ridge.

Kermesine, Carmine-red.

Kernel of the ovule and seed, 110.

Key, or *Key-fruit*, a Samara, 122.

Kidney-shaped, resembling the outline of a kidney, 53.

Labellum, the odd petal in the Orchis Family.

Labiate, same as *bilabiate* or two-lipped, 92.

Labiatiflorous, having flowers with bilabiate corolla.

Labium (plural, *Labia*), Latin for lip.

Lacerate, with margin appearing as if torn.

Laciniate, slashed; cut into deep narrow lobes or *Laciniae*.

Lactescent, producing milky juice, as does the Milkweed, &c.

Lacteus, Latin for milk-white.

Lacunose, full of holes or gaps.

Lacustrine, belonging to lakes.

Lævigata, smooth as if polished. Latin, *Lævis*, smooth, as opposed to rough.

Lageniform, gourd-shaped.

Lagopous, Latin, hare-footed; densely clothed with long soft hairs.

Lamellar or *Lamellate*, consisting of flat plates, *Lamellæ*.

Lamina, a plate or blade, the blade of a leaf, &c., 49.

Lanate, *Lanose*, woolly; clothed with long and soft entangled hairs.

Lanceolate, lance-shaped, 52.

Lanuginous, cottony or woolly.

Latent buds, concealed or undeveloped buds, 30.

Lateral, belonging to the side.

Latez, the milky juice, &c., of plants, 135.

Lax (*Laxus*), loose in texture, or sparse; the opposite of crowded.

Leaf, 49. *Leaf-buds*, 31.

Leaflet, one of the divisions or blades of a compound leaf, 57.

Leaf-like, same as *foliaceous*.

Leathery, of about the consistence of leather; coriaceous.

- Legume*, a simple pod which dehisces in two pieces, like that of the Pea, 122.
Leguminous, belonging to legumes, or to the Leguminous Family.
Lenticular, lens-shaped; i. e. flattish and convex on both sides.
Lappaceous, bur-like.
Lasio, Greek for woolly or hairy, as *Lasianthus*, woolly-flowered.
Lateritious, brick-colored.
Laticiferous, containing latex, 138.
Latus, Latin for broad, as *Latifolius*, broad-leaved.
Leaf-scar, *Leaf stalk*, petiole.
Lenticels, lenticular dots on young bark.
Lentiginose, as if freckled.
Lepal, a made-up word for a staminode.
Lepis, Greek for a scale, whence *Lepidote*, leprous; covered with scurfy scales.
Leptos, Greek for slender; so *Leptophyllous*, slender-leaved.
Leukos, Greek for white; whence *Leucanthous*, white-flowered, &c.
Liber, the inner bark of Exogenous stems, 140.
Lil, see *operculum*.
Lignecus, or *Lignose*, woody in texture.
Ligulate, furnished with a ligule, 93.
Ligule, *Ligula*, the strap-shaped corolla in many Compositæ, 93; the membranous appendage at the summit of the leaf-sheaths of most Grasses, 57.
Limb, the border of a corolla, &c., 89.
Limbate, bordered (Latin, *Limbus*, a border).
Line, the twelfth of an inch; or French lines, the tenth.
Linear, narrow and flat, the margins parallel, 52.
Lineate, marked with parallel lines. *Lineolate*, marked with minute lines.
Lingulate, *Linguiform*, tongue-shaped.
Lip, the principal lobes of a bilabiate corolla or calyx, 92.
Litoral or *Littoral*, belonging to the shore.
Livid, pale lead-colored.
Lobe, any projection or division (especially a rounded one) of a leaf, &c.
Lobed or *Lobate*, cut into lobes, 55, 56; *Lobulate*, into small lobes.
Locellate, having *Locelli*, i. e. compartments in a cell: thus an anther-cell is often *bilocellate*.
Loculament, same as *loculus*.
Locular, relating to the cell or compartment (*Loculus*) of an ovary, &c.
Loculicidal (dehiscence), splitting down through the back of each cell, 123.
Locusta, a name for the spikelet of Grasses.
Lodicule, one of the scales answering to perianth-leaves in Grass-flowers.
Loment, a pod which separates transversely into joints, 122.
Lomentaceous, pertaining to or resembling a loment.
Lorate, thong-shaped.
Lunate, crescent-shaped. *Lunulate*, diminutive of *lunate*.
Lupuline, like hops.
Lusus, Latin for a sport or abnormal variation.
Luteolus, yellowish; diminutive of
Luteus, Latin for yellow. *Lutescent*, verging to yellow.
Lyrate, lyre-shaped; a pinnatifid leaf of an obovate or spatulate outline, the end-lobe large and roundish, and the lower lobes small, as in fig. 149.
- Macros*, Greek for long, sometimes also used for large; thus *Macrophyllous*, long or large-leaved, &c.
Macrospore, the large kind of spore, when there are two kinds, 160, 161.
Maculate, spotted or blotched.
Male (flowers or plants), having stamens but no pistil.
Mammose, breast-shaped.
Marcrescent, withering without falling off.
Marginal, belonging to margin.

Marginate, margined with an edge different from the rest.

Marginicidal dehiscence, 123.

Maritime, belonging to sea-coasts.

Marmorate, marbled.

Mas., *Masc.*, *Masculine*, male.

Masked, see *personate*.

Mealy, see *farinaceous*.

Median, *Medial*, belonging to the middle.

Medifixed, attached by the middle.

Medullary, belonging to or of the nature of, pith (*Medulla*); pithy.

Medullary Rays, the silver-grain of wood, 140, 141.

Medullary Sheath, a set of ducts just around the pith, 140.

Meiostemonous, having fewer stamens than petals.

Membranaceous or *Membranous*, of the texture of membrane; thin and soft.

Meniscoid, crescent-shaped.

Mericarp, one carpel of the fruit of an Umbelliferous plant, 121.

Merismatic, separating into parts by the formation of partitions across.

Merous, from the Greek for part; used with numeral prefix to denote the number of pieces in a set or circle: as *Monomerous*, of only one, *Dimerous*, with two, *Trimerous*, with three parts (sepals, petals, stamens, &c.) in each circle.

Mesocarp, the middle part of a pericarp, when that is distinguishable into three layers, 120.

Mesophloëm, the middle or green bark.

Microphyle, the closed orifice of the seed, 110, 126.

Microspore, the smaller kind of spore when there are two kinds, 161.

Midrib, the middle or main rib of a leaf, 50.

Milk-vessels, 138.

Miniate, vermilion-colored

Mitriiform, mitre-shaped: in the form of a peaked cap, or one cleft at the top.

Moniliform, necklace-shaped; a cylindrical body contracted at intervals.

Monocarpic (duration), flowering and seeding but once, 38.

Monochlamydeous, having only one floral envelope.

Monocotyledonous (embryo), with only one cotyledon, 24.

Monocotyledonous Plants, 24. *Monocotyls*, 24.

Monœcious, or *Monoicous* (flower), having stamens (r pistils only), 85.

Monogynous (flower), having only one pistil, or one style, 105.

Monopetalous (flower), with the corolla of one piece, 89.

Monophyllous, one-leaved, or of one piece.

Monos, Greek for solitary or only one; thus *Monadelphous*, stamens united by their filaments into one set, 99; *Monandrous* (flower), having only one stamen, 100.

Monosepalous, a calyx of one piece; i. e. with the sepals united into one body.

Monospermous, one-seeded.

Monstrosity, an unnatural deviation from the usual structure or form.

Morphology, *Morphologic* *il Botany*, 9; the department of botany which treats of the forms which an organ may assume.

Moschate, Musk-like in odor.

Movements, 149.

Mucronate, tipped with an abrupt short point (*Mucro*), 54.

Mucronulate, tipped with a minute abrupt point; a diminutive of the last.

Multi-, in composition, many; as *Multangular*, many-angled; *Multicipital*, many-headed, &c.; *Multifarious*, in many rows or ranks; *Multifid*, many-cleft; *Multilocular*, many-celled; *Multiserial*, in many rows.

Multiple Fruits, 118, 124.

Muricate, beset with short and hard or prickly points.

Muriform, wall-like; resembling courses of bricks in a wall.

Muticous, pointless, blunt, unarmed.

Mycelium, the spawn of Fungi; i. e. the filaments from which Mushrooms, &c., originate, 172.

Naked, wanting some usual covering, as achlamydeous flowers, 86, gymnospermous seeds, 109, 125, &c.

Names in botany, 179.

Nanus, Latin for dwarf.

Napiform, turnip-shaped, 35.

Natural System, 182.

Naturalized, introduced from a foreign country, and flourishing wild.

Navicular, boat-shaped, like the glumes of most Grasses.

Necklace-shaped, looking like a string of beads; see *moniliform*.

Nectar, the sweet secretion in flowers from which bees make honey, &c.

Nectariferous, honey-bearing; or having a nectary.

Nectary, the old name for petals and other parts of the flower when of unusual shape, especially when honey-bearing. So the hollow spur-shaped petals of Columbine were called nectaries; also the curious long-clawed petals of Monks-hood, 87, &c.

Needle-shaped, long, slender, and rigid, like the leaves of Pines.

Nemorose or *Nemoral*, inhabiting groves.

Nerve, a name for the ribs or veins of leaves when simple and parallel, 50.

Nerved, furnished with nerves, or simple and parallel ribs or veins, 50.

Nervose, conspicuously nerved. *Nervulose*, minutely nervose.

Netted-veined, furnished with branching veins forming network, 50, 51

Neuter, *Neutral*, sexless. *Neutral flower*, 79.

Niger, Latin for black. *Nigricans*, Latin for verging to black.

Nitid, shining

Nival, living in or near snow. *Niveus*, snow-white.

Nodding, bending so that the summit hangs downward.

Node, a knot; the "joints" of a stem, or the part whence a leaf or a pair of leaves springs, 13.

Nodose, knotty or knobby. *Nodulose*, furnished with little knobs or knots.

Nomenclature, 175, 179.

Normal, according to rule, natural.

Notate, marked with spots or lines of a different color.

Nucamentaceous, relating to or resembling a small nut.

Nuciform, nut-shaped or nut-like.

Nucleus, the kernel of an ovule (110) or seed (127) of a cell.

Nucule, same as nutlet.

Nude, (Latin, *Nudus*), naked. So *Nudicaulis*, naked-stemmed, &c.

Nut, Latin *Nux*, a hard, mostly one-seeded indehiscent fruit; as a chestnut, butter-nut, acorn, 121.

Nutant, nodding.

Nutlet, a little nut; or the stone of a drupe.

Ob- (meaning over against), when prefixed to words signifies inversion; as, *Obcompressed*, flattened the opposite of the usual way; *Obcordate*, heart-shaped, with the broad and notched end at the apex instead of the base, 54; *Ob lanceolate*, lance-shaped with the tapering point downwards, 52.

Oblique, applied to leaves, &c., means unequal-sided.

Oblong, from two to four times as long as broad, 52.

Obovate, inversely ovate, the broad end upward, 53. *Obovoid*, solid obovate.

Obtuse, blunt or round at the end, 54.

Obverse, same as *inverse*.

Obvolute (in the bud), when the margins of one piece or leaf alternately overlap those of the opposite one.

Ocellate, with a circular colored patch, like an eye.

Ochroleucous, yellowish-white; dull cream-color.

Ocreate, furnished with *Ocreæ* (boots), or stipules in the form of sheaths, 57.

Octo-, Latin for eight, enters into the composition of *Octagynous*, with eight pistils or styles; *Octumerous*, its parts in eights; *Octandrous*, with eight stamens, &c.

Oculate, with eye-shaped marking.

Officinal, used in medicine, therefore kept in the shops.

Offset, short branches next the ground which take root, 40.

Oides, termination, from the Greek, to denote likeness; so *Dianthoides*, Pink-like.

Oleraceous, esculent, as a pot-herb.

Oligos, Greek for few; thus *Oliganthous*, few-flowered, &c.

Olivaceous, olive-green.

Oophoridium, a name for spore-case containing macrospores.

Opaque, applied to a surface, means dull, not shining.

Operculate, furnished with a lid (*Operculum*), as the spore-case of Mosses, 163.

Opposite, said of leaves and branches when on opposite sides of the stem from each other (i. e. in pairs), 29, 68. Stamens are opposite the petals, &c., when they stand before them.

Oppositifolius, situated opposite a leaf.

Orbicular, *Orbiculate*, circular in outline, or nearly so, 52.

Order, group below class, 178. *Ordinal names*, 180.

Organ, any member of the plant, as a leaf, a stamen, &c.

Organography, study of organs, 9. *Organogenesis*, that of the development of organs.

Orgyalis, of the height of a man.

Orthos, Greek for straight; thus, *Orthocarpous*, with straight fruit; *Orthostichous*, straight-ranked.

Orthotropous (ovule or seed), 111.

Osseous, of a bony texture.

Outgrowths, growths from the surface of a leaf, petal, &c.

Oval, broadly elliptical, 52.

Ovary, that part of the pistil containing the ovules or future seeds, 14, 80, 105.

Ovate, shaped like an egg, with the broader end downwards; or, in plain surfaces, such as leaves, like the section of an egg lengthwise, 52.

Ovoid, ovate or oval in a solid form.

Ovule, the body which is destined to become a seed, 14, 80, 105, 110.

Ovuliferous, ovule-bearing.

Palate, a projection of the lower lip of a labiate corolla into the throat, as in Snapdragon, &c.

Palea (plural *paleæ*), chaff; the inner husks of Grasses; the chaff or bracts on the receptacle of many Compositæ, as Coreopsis, and Sunflower.

Paleaceous, furnished with chaff, or chaffy in texture.

Paleolate, having *Paleolæ* or *paleæ* of a second order, or narrow *paleæ*.

Palet, English term for *palea*.

Palmate, when leaflets or the divisions of a leaf all spread from the apex of the petiole, like the hand with the outspread fingers, 57, 58.

Palmately (veined, lobed, &c.), in a palmate manner, 51, 56.

Palmatifid, -lobed, -sect, palmately cleft, or lobed, or divided.

Paludose, inhabiting marshes. *Palustrine*, same.

Panduriform, or *Pandurate*, fiddle-shaped (which see).

Panicle, an open and branched cluster, 81.

Panicked, *Paniculate*, arranged in panicles, or like a panicle.

Pannose, covered with a felt of woolly hairs.

Papery, of about the consistence of letter-paper.

Papilionaceous, butterfly-shaped; applied to such a corolla as that of the Pea, 91.

Papilla (plural *papillæ*), little nipple-shaped protuberances.

Papillate, *Papillose*, covered with *papillæ*.

Pappus, thistle-down. The down crowning the achenium of the Thistle, Groundsel, &c., and whatever in Compositæ answers to calyx, whether hairs, teeth, or scales, 121.

Papyraceous, like parchment in texture.

Parallel-veined or *nerved* (leaves), 50.

- Paraphyses*, jointed filaments mixed with the antheridia of Mosses.
- Parasitic*, living as a parasite, i. e. on another plant or animal, 37.
- Parenchymatous*, composed of parenchyma.
- Parenchyma*, soft cellular tissue of plants, like the green pulp of leaves, 132.
- Parietal* (placentæ, &c.), attached to the walls (*parietes*) of the ovary.
- Paripinnate*, pinnate with an even number of leaflets.
- Parted*, separated or cleft into parts almost to the base, 55.
- Parthenogenesis*, producing seed without fertilization.
- Partial involucre*, same as an *involucel*; *partial petiole*, a division of a main leaf-stalk or the stalk of a leaflet; *partial peduncle*, a branch of a peduncle; *partial umbel*, an umbellet, 76.
- Partition*, a segment of a *parted* leaf; or an internal wall in an ovary, anther, &c.
- Patelliform*, disk-shaped, like the *patella* or kneecap.
- Patent*, spreading, open. *Patulous*, moderately spreading.
- Pauci-*, in composition, few; as *pauciflorous*, few-flowered, &c.
- Pear-shaped*, solid obovate, the shape of a pear.
- Pectinate*, pinnatifid or pinnately divided into narrow and close divisions, like the teeth of a comb.
- Pedate*, like a bird's foot; palmate or palmately cleft, with the side divisions again cleft, as in *Viola pedata*, &c.
- Pedicel*, the stalk of each particular flower of a cluster, 73.
- Pedicellate*, *Pedicelled*, borne on a pedicel.
- Pedalis*, Latin for a foot high or long.
- Peduncle*, a flower-stalk, whether of a single flower or of a flower-cluster, 73.
- Peduncled*, *Pedunculate*, furnished with a peduncle.
- Peloria*, an abnormal return to regularity and symmetry in an irregular flower; commonest in Snapdragon.
- Peltate*, shield-shaped; said of a leaf, whatever its shape, when the petiole is attached to the lower side, somewhere within the margin, 53.
- Pelviciform*, basin-shaped.
- Pendent*, hanging. *Pendulous*, somewhat hanging or drooping.
- Penicillate*, *Penicilliform*, tipped with a tuft of fine hairs, like a painter's pencil; as the stigmas of some Grasses.
- Pennate*, same as pinnate. *Penninerved* and *Penniveined*, pinnately veined, 51.
- Penta-* (in words of Greek composition), five; as *Pentadelphous*, 99; *Pentagynous*, with five pistils or styles; *Pentamerous*, with its parts in fives, or on the plan of five; *Pentandrous*, having five stamens, 112; *Pentastichous*, in five ranks, &c.
- Pepo*, a fruit like the Melon and Cucumber, 119.
- Perennial*, lasting from year to year, 38.
- Perfect* (flower), having both stamens and pistils, 51.
- Perfoliate*, passing through the leaf, in appearance, 60.
- Perforate*, pierced with holes, or with transparent dots resembling holes, as an Orange-leaf.
- Peri-*, Greek for around; from which are such terms as
- Perianth*, the leaves of the flower collectively, 79.
- Pericarp*, the ripened ovary; the walls of the fruit, 117.
- Pericarpic*, belonging to the pericarp.
- Perigonium*, *Perigone*, same as *perianth*.
- Perigynium*, bodies around the pistil; applied to the closed cup or bottle-shaped body (of bracts) which encloses the ovary of Sedges, and to the bristles, little scales, &c., of the flowers of some other Cyperacæ.
- Perigynous*, the petals and stamens borne on the calyx, 95, 99.
- Peripheric*, around the outside, or periphery, of any organ.
- Perisperm*, a name for the albumen of a seed.
- Peristome*, the fringe of teeth to the spore-case of Mosses, 163.
- Persistent*, remaining beyond the period when such parts commonly fall, as the leaves of evergreens, and the calyx of such flowers as persist during the growth of the fruit.

- Personate*, masked; a bilabiate corolla with a *palate* in the throat, 92.
- Pertuse*, perforated with a hole or slit.
- Perulate*, having scales (*Perulæ*), such as bud-scales.
- Pes, pedis*, Latin for the foot or support, whence *Longipes*, long-stalked, &c.
- Petal*, a leaf of the corolla, 14, 79.
- Petalody*, metamorphosis of stamens, &c., into petals.
- Petaloid*, *Petaline*, petal-like; resembling or colored like petals.
- Petiole*, a footstalk of a leaf; a leaf stalk, 49.
- Petioled*, *Petiolate*, furnished with a petiole.
- Petiolulate*, said of a leaflet when raised on its own partial leafstalk.
- Phævus*, Latin for growing on rocks.
- Phalanx, phalanges*, bundles of stamens.
- Phænogamous*, or *Phanerogamous*, plants bearing flowers and producing seeds, same as Flowering Plants. *Phænogams, Phanerogams*, 10.
- Phlæum*, Greek name for bark, whence *Endophlæum*, inner bark, &c.
- Phæniceous*, deep red verging to scarlet.
- Phycology*, the botany of Algæ.
- Phyllocladia*, branches assuming the form and function of leaves.
- Phyllodium* (plural, *phyllodia*), a leaf where the seeming blade is a dilated petiole, as in New Holland Acacias, 61.
- Phyllome*, foliar parts, those answering to leaves in their nature.
- Phyllon* (plural, *phylla*), Greek for leaf and leaves; used in many compound terms and names.
- Phyllotaxis*, or *Phyllotaxy*, the arrangement of leaves on the stem, 67.
- Physiological Botany*, 9.
- Phytography*, relates to characterizing and describing plants.
- Phyton*, or *Phytomer*, a name used to designate the pieces which by their repetition make up a plant, theoretically, viz. a joint of stem with its leaf or pair of leaves.
- Pileus* of a mushroom, 172.
- Piliferous*, bearing a slender bristle or hair (*pilum*), or beset with hairs.
- Pilose*, hairy; clothed with soft slender hairs.
- Pinna*, a primary division with its leaflets of a bipinnate or tripinnate leaf.
- Pinnule*, a secondary division of a bipinnate or tripinnate leaf, 66.
- Pinnate* (leaf), when leaflets are arranged along the sides of a common petiole, 57.
- Pinnately lobed, cleft, parted, divided, veined*, 56.
- Pinnatifid, Pinnatisect*, same as pinnately cleft and pinnately parted, 56.
- Pisiform*, pea-shaped.
- Pistil*, the seed-bearing organ of the flower, 14, 80, 105.
- Pistillate*, having a pistil, 85.
- Pistillidium*, the body which in Mosses answers to the pistil, 159, 164.
- Pitchers*, 64.
- Pith*, the cellular centre of an exogenous stem, 138.
- Placenta*, the surface or part of the ovary to which the ovules are attached, 107.
- Placentiform*, nearly same as quoit-shaped.
- Plaited* (in the bud), or *Plicate*, folded, 72, 98.
- Platy-*, Greek for broad, in compounds, such as *Platyphyllous*, broad-leaved, &c.
- Pleio-*, Greek for full or abounding, used in compounds, such as *Pleiopetalous*, of many petals, &c.
- Plumbeus*, lead-colored.
- Plumose*, feathery; when any slender body (such as a bristle of a pappus or a style) is beset with hairs along its sides, like the plume of a feather.
- Plumule*, the bud or first shoot of a germinating plantlet above the cotyledons, 13.
- Pluri-*, in composition, many or several; as *Plurifoliolate*, with several leaflets.
- Pod*, specially a legume, 122; also may be applied to any sort of capsule.
- Podium*, a footstalk or stipe, used only in Greek compounds, as (suffixed) *Leptopodus*, slender-stalked, or (prefixed) *Podocephalus*, with a stalked head, and in *Podosperm*, a seed stalk or funiculus.
- Pogon*, Greek for beard, comes into various compounds.

- Pointless*, destitute of any pointed tip, such as a *muco*, *awn*, *acumination*, &c.
- Pollen*, the fertilizing powder contained in the anther, 14, 80, 103.
- Pollen-growth*, 117. *Polleniferous*, pollen-bearing.
- Pollen-mass*, *Pollinium*, the united mass of pollen, 104, as in Milkweed and Orchis.
- Pollinaris*, Latin for an inch long.
- Pollination*, the application of pollen to the stigma, 114.
- Poly-*, in compound words of Greek origin, same as *multi-* in those of Latin origin, viz. many, as
- Polyndelphous*, stamens united by their filaments into several bundles, 100.
- Polyandrous*, with numerous stamens (inserted on the receptacle), 100.
- Polycarpic*, term used by DeCandolle in the sense of perennial.
- Polycotyledonous*, having many (more than two) cotyledons, as Pines, 23.
- Polygamous*, having some perfect and some unisexual flowers, 85.
- Polygonal*, many-angled.
- Polygynous*, with many pistils or styles, 105.
- Polymerous*, formed of many parts of each set.
- Polymorphous*, of several or varying forms.
- Polypetalous*, when the petals are distinct or separate (whether few or many), 89.
- Polyphyllous*, many-leaved; formed of several distinct pieces.
- Polysepalous*, same as the last when applied to the calyx, 89.
- Polyspermous*, many-seeded.
- Pome*, the apple, pear, and similar fleshy fruits, 119.
- Pomiferous*, pome-bearing.
- Porrect*, outstretched.
- Posterior* side or portion of a flower (when axillary) is that toward the axis, 96.
- Pouch*, the silicle or short pod, as of Shepherd's Purse, 123.
- Præcocious* (Latin, *præ-cœ*), unusually early in development.
- Præfloration*, same as *æstivation*, 97.
- Præfoliation*, same as *vernation*, 71.
- Præmorse*, ending abruptly, as if bitten off.
- Pratensis*, Latin for growing in meadows.
- Prickles*, sharp elevations of the bark, coming off with it, as of the Rose.
- Prickly*, bearing prickles, or sharp projections like them.
- Primine*, the outer coat of the covering of the ovule, 110.
- Primordial*, earliest formed; primordial leaves are the first after the cotyledons.
- Prismatic*, prism-shaped; having three or more angles bounding flat sides.
- Procerous*, tall, or tall and slim.
- Process*, any projection from the surface or edge of a body.
- Procumbent*, trailing on the ground, 39.
- Procurrent*, running through but not projecting.
- Produced*, extended or projecting; the upper sepal of a Larkspur is *produced* above into a spur, 87.
- Proliferous* (literally, bearing offspring), where a new branch rises from an older one, or one head or cluster of flowers out of another.
- Propaculum* or *Propagulum*, a shoot for propagation.
- Prosenchyma*, a tissue of wood-cells.
- Prostrate*, lying flat on the ground, 39.
- Protandrous* or *Proterandrous*, the anthers first maturing, 116.
- Proteranthous*, flowering before leafing.
- Proterogynous* or *Protogynous*, the stigmas first to mature, 116.
- Prothallium* or *Prothallus*, 160.
- Protoplasm*, the soft nitrogenous lining or contents, or living part, of cells, 129.
- Protos*, Greek for first; in various compounds.
- Pruinose*, *Pruinate*, frosted; covered with a powder like hoar-frost.
- Pseudo-*, Greek for false. *Pseudo-bulb*, the aerial corms of epiphytic Orchids, &c.
- Pseudos*, Greek for bare or naked, used in many compounds.
- Pteridophyta*, *Pteridophytes*, 156.
- Pteris*, Greek for wing, and general name for Fern, enters into many compounds.

- Puberulent*, covered with fine and short or almost imperceptible down.
Pubescent, hairy or downy, especially with fine and soft hairs or *pubescence*.
Pulverulent or *Pulveraceous*, as if dusted with fine powder.
Pulvinate, cushioned, or shaped like a cushion.
Pumilus, low or little.
Punctate, dotted, either with minute holes or what look as such.
Puncticulate, minutely punctate.
Pungent, prickly-tipped.
Puniceous, carmine-red.
Purpureus, originally red or crimson, more used for duller or bluish-red.
Pusillus, weak and small, tiny.
Putamen, the stone of a drupe, or the shell of a nut, 120.
Pygmæus, Latin for dwarf.
Pyramidal, shaped like a pyramid.
Pyrene, *Pyrena*, a seed-like nutlet or stone of a small drupe.
Pyriform, pear-shaped.
Pyxidate, furnished with a lid.
Pyxis, *Pyxidium*, a pod opening round horizontally by a lid, 124.
- Quadri-*, in words of Latin origin, four; as *Quadrangular*, four-angled; *Quadri-foliate*, four-leaved; *Quadrifid*, four-cleft. *Quaternate* in fours.
Quinate, in fives. *Quinque*, five.
Quincuncial, in a quincunx; when the parts in æstivation are five, two of them outside, two inside, and one half out and half in.
Quintuple, five-fold.
- Race*, a marked variety which may be perpetuated from seed, 176.
Raceme, a flower-cluster, with one-flowered pedicels arranged along the sides of a general peduncle, 73.
Racemose, bearing racemes, or raceme-like.
Rachis, see *rhachis*.
Radial, belonging to the ray.
Radiate, or *Radiant*, furnished with ray-flowers, 94.
Radiate-veined, 52.
Radical, belonging to the root, or apparently coming from the root.
Radicant, rooting, taking root on or above the ground.
Radicels, little roots or rootlets.
Radicle, the stem part of the embryo, the lower end of which forms the root, 11, 127.
Rameal, belonging to a branch. *Ramose*, full of branches (*rami*).
Ramentaceous, beset with thin chaffy scales (*Ramenta*), as the stalks of many Ferns.
Ramification, branching, 27.
Ramulose, full of branchlets (*ramuli*).
Raphe, see *rhaphe*.
Ray, parts diverging from a centre, the marginal flowers of a head (as of *Coreopsis*, 94), or cluster, as of *Hydrangea* (78), when different from the rest, especially when ligulate and diverging (like rays or sunbeams); also the branches of an umbel, 74.
Ray-flowers, 94.
Receptacle, the axis or support of a flower, 81, 112; also the common axis or support of a head of flowers, 73.
Reclined, turned or curved downwards; nearly recumbent.
Rectinerved, with straight nerves or veins.
Recurved, curved outwards or backwards.
Reduplicate (in æstivation), valvate with the margins turned outwards, 97.
Reflexed, bent outwards or backwards.
Refracted, bent suddenly, so as to appear broken at the bend.
Regular, all the parts similar in shape, 82.
Reniform, kidney-shaped, 53.

Repand, wavy-margined, 55.

Repent, creeping, i. e. prostrate and rooting underneath.

Replum, the frame of some pods (as of Prickly Poppy and Cress), persistent after the valves fall away.

Reptant, same as repent.

Resupinate, inverted, or appearing as if upside down, or reversed.

Reticulated, the veins forming network, 50. *Retiform*, in network.

Retinerved, reticulate-veined.

Retroflected, bent backwards; same as *reflexed*.

Retuse, blunted; the apex not only obtuse but somewhat indented, 54.

Revolute, rolled backwards, as the margins of many leaves, 72.

Rhachis (the backbone), the axis of a spike or other body, 73.

Rhaphe, the continuation of the seed-stalk along the side of an anatropous ovule or seed, 112, 126.

Rhaphides, crystals, especially needle-shaped ones, in the tissues of plants, 137.

Rhizanthous, flowering from the root.

Rhizoma, *Rhizome*, a rootstock, 42-44.

Rhombic, in the shape of a rhomb. *Rhomboidal*, approaching that shape.

Rib, the principal piece, or one of the principal pieces of the framework of a leaf, or any similar elevated line along a body, 49, 50.

Rimose, having chinks or cracks.

Ring, an elastic band on the spore-cases of Feras, 159.

Ringent, grinning; gaping open, 92.

Riparious, on river-banks.

Rivalis, Latin for growing along brooks; or *Ricularis*, in rivulets.

Root, 33.

Root-hairs, 35.

Rootlets, small roots, or root-branches, 33.

Rootstock, root-like trunks or portions of stems on or under ground, 42.

Roridus, dewy.

Rosaceous, arranged like the petals of a rose.

Rostellate, bearing a small beak (*Rostellum*).

Rostrate, bearing a beak (*Rostrum*) or a prolonged appendage.

Rosulate, in a rosette or cluster of spreading leaves.

Rotate, wheel-shaped, 89.

Rotund, rounded or roundish in outline.

Ruber, Latin for red in general. *Rubescens*, *Rubicund*, reddish or blushing.

Rudimentary, imperfectly developed, or in an early state of development.

Rufus, *Rufescent*, brownish-red or reddish-brown.

Rugose, wrinkled; roughened with wrinkles.

Ruminated (albumen), penetrated with irregular channels or portions, as a nutmeg, looking as if chewed.

Runcinate, coarsely saw-toothed or cut, the pointed teeth turned towards the base of the leaf, as the leaf of a Dandelion.

Runner, a slender and prostrate branch, rooting at the end, or at the joints, 40.

Sabulose, growing in sand.

Sac, any closed membrane, or a deep purse-shaped cavity.

Saccate, sac-shaped.

Sagittate, arrowhead-shaped, 53.

Salsuginous, growing in brackish soil.

Salver-shaped, or *Salver-form*, with a border spreading at right angles to a slender tube, 89.

Samara, a wing-fruit, or key, 122.

Samaroid, like a samara or key-fruit.

Sap, the juices of plants generally, 136. *Sapwood*, 142.

Saprophytes, 37.

Sarcocarp, the fleshy part of a stone-fruit, 120.

- Sarmentaceous, Sarmentose*, bearing long and flexible twigs (*Sarments*), either spreading or procumbent.
- Saw-toothed*, see *serrate*, 55.
- Scabrous*, rough or harsh to the touch.
- Scalariform*, with cross-bands, resembling the steps of a ladder, 134.
- Scales*, of buds, 28; of bulbs, &c., 46.
- Scalloped*, same as *crenate*, 55.
- Scaly*, furnished with scales, or scale-like in texture.
- Scandent*, climbing, 39.
- Scape*, a peduncle rising from the ground or near it, as in many *Violets*.
- Scapiform*, scape-like.
- Scapigerous*, scape-bearing.
- Scar* of the seed, 126. *Leaf-scars*, 27, 28.
- Scarious* or *Scariose*, thin, dry, and membranous.
- Scion*, a shoot or slip used for grafting.
- Scleros*, Greek for hard, hence *Sclerocarpous*, hard-fruited.
- Scobiform*, resembling sawdust.
- Scorpioid* or *Scorpioidal*, curved or circinate at the end, 77.
- Scrobiculate*, pitted; excavated into shallow pits.
- Scurf, Scurfiness*, minute scales on the surface of many leaves, as of *Goosefoot*.
- Scutate, Scutiform*, buckler-shaped.
- Scutellate, or Scutelliform*, saucer-shaped or platter-shaped.
- Secund, cne-sided*; i. e. where flowers, leaves, &c., are all turned to one side.
- Secundine*, the inner coat of the ovule, 110.
- Seed*, 125. *Seed-leaves*, see *cotyledons*. *Seed-vessel*, 127.
- Segment*, a subdivision or lobe of any cleft body.
- Segregate*, separated from each other.
- Semi-*, in compound words of Latin origin, half; as
- Semi-adherent*, as the calyx or ovary of *Purslane*; *Semicordate*, half-heart-shaped;
- Semilunar*, like a half-moon; *Semiovate*, half-ovate, &c.
- Seminal*, relating to the seed (*Semen*). *Seminiferous*, seed-bearing.
- Sempervirent*, evergreen.
- Sensitiveness* in plants, 149, 152.
- Senary*, in sixes.
- Sepal*, a leaf or division of the calyx, 14, 79.
- Sepaloid*, sepal-like. *Sepaline*, relating to the sepals.
- Separated Flowers*, those having stamens or pistils only, 85.
- Septate*, divided by partitions.
- Septenate*, with parts in sevens.
- Septicidal*, where dehiscence is through the partitions, 123.
- Septiferous*, bearing the partition.
- Septifragal*, where the valves in dehiscence break away from the partitions, 123.
- Septum* (plural *septa*), a partition or dissepiment.
- Serial, or Seriate*, in rows; as *biserial*, in two rows, &c.
- Sericeous*, silky; clothed with satiny pubescence.
- Serotinous*, late in the season.
- Serrate*, the margin cut into teeth (*Serratures*) pointing forwards, 55.
- Serrulate*, same as the last, but with fine teeth.
- Sessile*, sitting; without any stalk.
- Sesqui-*, Latin for one and a half; so *Sesquipedalis*, a foot and a half long.
- Seta*, a bristle, or a slender body or appendage resembling a bristle.
- Setaceous*, bristle-like. *Setiform*, bristle-shaped.
- Setigerous*, bearing bristles. *Setose*, beset with bristles or bristly hairs.
- Setula*, a diminutive bristle. *Setulose*, provided with such.
- Sex, six. Sexangular*, six-angled. *Sexfarious*, six-faced.
- Sheath*, the base of such leaves as those of *Grasses*, which are
- Sheathing*, wrapped round the stem.
- Shield-shaped*, same as *scutate*, or as *plute*, 53.

Shrub, Shrubby, 39.

Sieve-cells, 140.

Sigmoid, curved in two directions, like the letter S, or the Greek *sigma*.

Silicle, a pouch, or short pod of the Cress Family, 123.

Siliculose, bearing a silicle, or a fruit resembling it.

Silique, capsule of the Cress Family, 123.

Siliquose, bearing siliques or pods which resemble siliques.

Silky, glossy with a coat of fine and soft, close-pressed, straight hairs.

Silver-grain, the medullary rays of wood, 139.

Silvery, shining white or bluish-gray, usually from a silky pubescence.

Simple, of one piece; opposed to *compound*.

Sinistorse, turned to the left.

Sinuate, with margin alternately bowed inwards and outwards, 55.

Sinus, a recess or bay; the re-entering angle between two lobes or projections.

Sleep of Plants (so called), 151.

Smooth, properly speaking not rough, but often used for glabrous, i. e. not pubescent.

Soboliferous, bearing shoots (*Soboles*) from near the ground.

Solitary, single; not associated with others.

Sordid, dull or dirty in hue.

Sorediate, bearing patches on the surface.

Sorosis, name of a multiple fruit, like a pine-apple.

Sorus, a fruit-dot of Ferns, 159.

Spadiceous, chestnut-colored. Also spadix-bearing.

Spadix, a fleshy spike of flowers, 75.

Span, the distance between the tip of the thumb and of little finger outstretched, six or seven inches.

Spathaceous, resembling or furnished with a

Spathe, a bract which inwraps an inflorescence, 75.

Spatulate, or *Spathulate*, shaped like a spatula, 52.

Species, 175.

Specific Names, 179.

Specimens, 184.

Spermaphore, or *Spermophore*, one of the names of the placenta.

Spermum, Latin form of Greek word for seed; much used in composition.

Spica, Latin for spike; hence *Spicate*, in a spike, *Spiciform*, in shape resembling a spike.

Spike, an inflorescence like a raceme, only the flowers are sessile, 74.

Spikelet, a small or a secondary spike; the inflorescence of Grasses.

Spine, 41, 64.

Spindle-shaped, tapering to each end, like a radish, 36.

Spinescent, tipped by or degenerating into a thorn.

Spinose, or *Spiniferous*, thorny.

Spiral Vessels or ducts, 135.

Spithameous, span-high.

Spora, Greek name for seed, used in compound words.

Sporadic, widely dispersed.

Sporangium, a spore-case in Ferns, &c., 158.

Spore, a body resulting from the fructification of Cryptogamous plants, in them the analogue of a seed.

Spore-case (*Sporangium*), 158.

Sporocarp, 162.

Sport, a newly appeared variation, 176.

Sporule, same as a spore, or a small spore.

Spumescens, appearing like froth.

Spur, any projecting appendage of the flower, looking like a spur but hollow, as that of Larkspur, fig. 239.

Squamate, *Squamosa*, or *Squamaceous*, furnished with scales (*squamæ*).

- Squamellate*, or *Squamulose*, furnished with little scales (*Squamellæ*, or *Squamulæ*).
Squamiform, shaped like a scale.
Squarrose, where scales, leaves, or any appendages spread widely from the axis or which they are thickly set.
Squarrulose, diminutive of *squarrose*; slightly squarrose.
Stachys, Greek for spike.
Stalk, the stem, petiole, peduncle, &c., as the case may be.
Stamen, 14, 80, 98.
Staminate, furnished with stamens, 86. *Stamineal*, relating to the stamens.
Staminodium, an abortive stamen, or other body in place of a stamen.
Standard, the upper petal of a papilionaceous corolla, 92.
Starch, 136, 163.
Station, the particular kind of situation in which a plant naturally occurs.
Stellate, *Stellular*, starry or star-like; where several similar parts spread out from a common centre, like a star.
Stem, 39. *Stemle*., diminutive stem.
Stemless, destitute or apparently destitute of stem.
Stenos, Greek for narrow; hence *Stenophyllous*, narrow-leaved, &c.
Sterile, barren or imperfect.
Stigma, the part of the pistil which receives the pollen, 14, 80, 105.
Stigmatic, or *Stigmatose*, belonging to the stigma.
Stipe (Latin *Stipes*), the stalk of a pistil, &c., when it has any, 112; also of a Fern, 158, and of a Mushroom, 172.
Stipel, a stipule of a leaflet. as of the Bean, &c.
Stipellate, furnished with stipels, as in the Bean tribe.
Stipitate, furnished with a stipe.
Stipulaceous, belonging to stipules. *Stipulate*, furnished with stipules.
Stipules, the appendages one each side of the base of certain leaves, 66.
Stirps (plural, *stirpes*), Latin for race.
Stock, used for race or source. Also for any root-like base from which the herb grows up.
Stole, or *Stolon*, a trailing or reclined and rooting shoot, 40.
Stoloniferous, producing stolons.
Stomate (Latin *Stoma*, plural *Stomata*), the breathing-pores of leaves, 144.
Stone-fruit, 119.
Storage-leaves, 62.
Stramineous, straw-like, or straw-colored.
Strap-shaped, long, flat, and narrow.
Striate, or *Striated*, marked with slender longitudinal grooves or stripes.
Strict, close and narrow; straight and narrow.
Strigillase, *Strigose*, beset with stout and appressed, stiff or rigid bristles.
Strobilaceous, relating to or resembling a
Strobile, a multiple fruit in the form of a cone or head, 124.
Strombuliform, twisted, like a spiral shell.
Strophiole, same as *caruncle*, 126. *Strophiolate*, furnished with a strophiole.
Struma, a wen; a swelling or protuberance of any organ.
Strumose, bearing a struma.
Stupose, like tow.
Style, a stalk between ovary and stigma, 14, 80, 105.
Styliferous, *Stylose*, bearing styles or conspicuous ones.
Stylopodium, an epigynous disk, or an enlargement at the base of the style.
Sub-, as a prefix, about, nearly, somewhat; as *Subcordate*, slightly cordate; *Subseriate*, slightly serrate; *Subaxillary*, just beneath the axil, &c.
Subclass, *Suborder*, *Subtribe*, 178.
Suberose, corky or cork-like in texture.
Subulate, awl-shaped; tapering from a broadish or thickish base to a sharp point.
Succise, as if cut off at lower end.
Succubous, when crowded leaves are each covered by base of next above.

- Suckers*, shoots from subterranean branches, 39.
Suffrutescent, slightly shrubby or woody at the base only, 39.
Suffruticose, rather more than suffrutescent, 37, 39.
Sulcate, grooved longitudinally with deep furrows.
Superior, above, 96; sometimes equivalent to posterior, 96.
Supernumerary Buds, 30, 31.
Supervolute, plaited and convolute in bud, 97.
Supine, lying flat, with face upward.
Supra-axillary, borne above the axil, as some buds, 31.
Supra-decompound, many times compounded or divided.
Surculose, producing suckers (*Surculi*) or shoots resembling them.
Suspended, hanging down. Suspended ovules or seeds hang from the very summit of the cell which contains them.
Sutural, belonging or relating to a suture.
Suture, the line of junction of contiguous parts grown together, 106.
Sword-shaped, applied to narrow leaves, with acute parallel edges, tapering above.
Syeonium, the fig-fruit, 124.
Sylvestrine, growing in woods.
Symmetrical Flower, similar in the number of parts of each set, 82.
Sympetalous, same as gamopetalous.
Sympode, *Sympodium*, a stem composed of a series of superposed branches in such a way as to imitate a simple axis, as in Grape-vine.
Synantherous or *Syngenesious*, where stamens are united by their anthers, 100.
Syncarpous (fruit or pistil), composed of several carpels consolidated into one.
Synonym, an equivalent superseded name.
Synsepalous, same as gamosepalous.
System (artificial and natural), 182, 183.
Systematic Botany, the study of plants after their kinds, 9.
- Tabescent*, wasting or shrivelling.
Tail, any long and slender prolongation of an organ.
Taper-pointed, same as acuminate, 54.
Tap-root, a root with a stout tapering body, 32-35.
Tawny, dull yellowish, with a tinge of brown.
Taxonomy, the part of botany which treats of classification.
Tegmen, a name for the inner seed-coat.
Tendril, a thread-shaped organ used for climbing, 40.
Terete, long and round; same as *cylindrical*, only it may taper.
Terminal, borne at, or belonging to, the extremity or summit.
Terminology treats of technical terms; same as *Glossology*, 181.
Ternate, *Ternately*, in threes.
Tessellate, in checker-work.
Testa, the outer (and usually the harder) coat or shell of the seed, 125.
Testaceous, the color of unglazed pottery.
Tetra- (in words of Greek composition), four; as, *Tetracoccus*, of four cocci.
Tetradynamous, where a flower has six stamens, two shorter than the four, 101.
Tetragonal, four-angled. *Tetragynous*, with four pistils or styles. *Tetramerous*, with its parts or sets in fours. *Tetrandrous*, with four stamens, 100.
Tetraspore, a quadruple spore, 169.
Thalamiflorous, with petals and stamens inserted on the torus or *Thalamus*.
Thallophyta, *Thallophytes*, 165.
Thallus, a stratum, in place of stem and leaves, 165.
Theca, a case; the cells or lobes of the anther.
Thecaphore, the stipe of a carpel, 113.
Thorn, an indurated pointed branch, 41, 42.
Thread-shaped, slender and round or roundish, like a thread.
Throat, the opening or gorge of a monopetalous corolla, &c., where the border and the tube join, and a little below, 89.

- Thyrse* or *Thyrus*, a compact and pyramidal panicle of cymes or cymules, 79.
- Tomentose*, clothed with matted woolly hairs (*tomentum*).
- Tongue-shaped*, long and flat, but thickish and blunt.
- Toothed*, furnished with teeth or short projections of any sort on the margin; used especially when these are sharp, like saw-teeth, and do not point forwards, 55.
- Top-shaped*, shaped like a top, or a cone with apex downwards.
- Torose*, *Torulose*, knobby; where a cylindrical body is swollen at intervals.
- Torus*, the receptacle of the flower, 81, 112.
- Trachea*, a spiral duct.
- Trachys*, Greek for rough; used in compounds, as, *Trachyspermous*, rough-seeded.
- Transverse*, across, standing right and left instead of fore and aft.
- Tri-* (in composition), three; as,
- Triadelphous*, stamens united by their filaments into three bundles, 99.
- Triandrous*, where the flower has three stamens, 112.
- Tribe*, 178.
- Trichome*, of the nature of hair or pubescence.
- Trichotomous*, three-forked. *Tricoccous*, of three cocci or roundish carpels.
- Tricolor*, having three colors. *Tricostate*, having three ribs.
- Tricuspidate*, three-pointed. *Tridentate*, three-toothed.
- Triennial*, lasting for three years.
- Trifarious*, in three vertical rows; looking three ways.
- Trifid*, three-cleft, 56.
- Trifoliate*, three-leaved. *Trifoliolate*, of three leaflets.
- Trifurcate*, three-forked. *Trigonus*, three-angled, or triangular.
- Trigynous*, with three pistils or styles, 116. *Trijugate*, in three pairs (*jugi*).
- Trilobed* or *Trilobate*, three-lobed, 55.
- Trilocular*, three-celled, as the pistils or pods in fig. 328-330.
- Trimerous*, with its parts in threes. *Trimorphism*, 117. *Trimorphic* or *Trimorphous*, in three forms.
- Trinervate*, three-nerved, or with three slender ribs.
- Triæcious*, where there are three sorts of flowers on the same or different individuals, as in Red Maple. A form of Polygamous.
- Tripartible*, separable into three pieces. *Tripartite*, three-parted, 55.
- Tripetalous*, having three petals.
- Triphyllous*, three-leaved; composed of three pieces.
- Tripinnate*, thrice pinnate, 59. *Tripinnatifid*, thrice pinnately cleft, 57.
- Triple-ribbed*, *Triple-nerved*, &c., where a midrib branches into three, near the base of the leaf.
- Triquetrous*, sharply three-angled; and especially with the sides concave, like a bayonet.
- Triserial*, or *Triseriate*, in three rows, under each other.
- Tristichous*, in three longitudinal or perpendicular ranks.
- Tristigmatic*, or *Tristigmatose*, having three stigmas.
- Trisulcate*, three-grooved.
- Tritermate*, three times ternate, 59.
- Trivial Name*, the specific name.
- Trochlear*, pulley-shaped.
- Trumpet-shaped*, tubular; enlarged at or towards the summit.
- Truncate*, as if cut off at the top.
- Trunk*, the main stem or general body of a stem or tree.
- Tube* (of corolla, &c.), 89.
- Tuber*, a thickened portion of a subterranean stem or branch, provided with eyes (buds) on the sides, 44.
- Tubercle*, a small excrescence.
- Tubercled*, or *Tuberculate*, bearing excrescences or pimples.
- Tubæform*, trumpet-shaped.
- Tuberous*, resembling a tuber. *Tuberiferous*, bearing tubers.
- Tubular*, hollow and of an elongated form; hollowed like a pipe, 91.

Tubuliflorous, bearing only tubular flowers.

Tunicate, coated; invested with layers, as an onion, 46.

Turbinate, top-shaped.

Turio (plural *turions*), strong young shoots or suckers springing out of the ground; as *Asparagus-shoots*.

Turnip-shaped, broader than high, abruptly narrowed below, 35.

Twining, ascending by coiling round a support, 39.

Type, the ideal pattern, 10.

Typical, well exemplifying the characteristics of a species, genus, &c.

Uliginose, growing in swamps.

Umbel, the umbrella-like form of inflorescence, 74.

Umbellate, in umbels. *Umbelliferous*, bearing umbels.

Umbellet (*umbellula*), a secondary or partial umbel, 76.

Umbilicate, depressed in the centre, like the ends of an apple; with a navel.

Umbonate, bossed; furnished with a low, rounded projection like a boss (*umbo*).

Umbraculiform, umbrella-shaped.

Unarmed, destitute of spines, prickles, and the like.

Uncial, an inch (*uncia*) in length.

Uncinate, or *Uncate*, hook-shaped; hooked over at the end.

Under-shrub, partially shrubby, or a very low shrub.

Undulate, or *Undate*, wavy, or wavy-margined, 55.

Unequally pinnate, pinnate with an odd number of leaflets, 65.

Unguiculate, furnished with a claw (*unguis*), 91.

Uni-, in compound words, one; as *Unicellular*, one-celled.

Uniflorous, one-flowered. *Unifoliate*, one-leaved.

Unifoliate, of one leaflet, 59. *Unijugate*, of one pair.

Unilabiate, one-lipped. *Unilateral*, one-sided.

Unilocular, one-celled. *Uniovulate*, having only one ovule.

Uniserial, in one horizontal row.

Unisexual, having stamens or pistils only, 85.

Univalved, a pod of only one piece after dehiscence.

Unsymmetrical Flowers, 86.

Urceolate, urn-shaped.

Utricle, a small thin-walled, one-seeded fruit, as of Goosefoot, 121.

Utricular, like a small bladder.

Vaginate, sheathed, surrounded by a sheath (*vagina*).

Valve, one of the pieces (or doors) into which a dehiscent pod, or any similar body, splits, 122, 123.

Valvate, *Valvular*, opening by valves. *Valvate*, in aestivation, 97.

Variety, 176.

Vascular, containing vessels, or consisting of vessels or ducts, 134.

Vascular Cryptogams, 156.

Vaulted, arched; same as *fornicate*.

Vegetable Life, &c., 128. *Vegetable anatomy*, 129.

Veins, the small ribs or branches of the framework of leaves, &c., 49, 50.

Veined, *Veiny*, furnished with evident veins. *Veinless*, destitute of veins.

Veinlets, the smaller ramifications of veins, 50.

Velate, furnished with a veil.

Velutinous, velvety to the touch.

Venation, the veining of leaves, &c., 50.

Venenate, poisonous.

Venose, veiny; furnished with conspicuous veins.

Ventral, belonging to that side of a simple pistil, or other organ, which looks towards the axis or centre of the flower; the opposite of dorsal; as the

Ventral Suture, 106.

Ventricose, inflated or swelled out on one side.

- Venulose*, furnished with veinlets.
Vermicular, worm-like, shaped like worms.
Vernal, belonging to spring.
Vernation, the arrangement of the leaves in the bud, 71.
Vernicose, the surface appearing as if varnished.
Verrucose, warty; beset with little projections like warts.
Versatile, attached by one point, so that it may swing to and fro, 101.
Vertex, same as *apex*.
Vertical, upright, perpendicular to the horizon, lengthwise.
Verticil, a whorl, 68. *Verticillate*, whorled, 68.
Verticillaster, a false whorl, formed of a pair of opposite cymes.
Vesicular, bladdery.
Vespertine, appearing or expanding at evening.
Vessels, ducts, &c., 134.
Vexillary, *Vexillar*, relating to the
Vexillum, the standard of a papilionaceous flower, 92.
Villose, shaggy with long and soft hairs (*Vilosity*).
Vimineous, producing slender twigs, such as those used for wicker-work.
Vine, in the American use, any trailing or climbing stem; as a Grape-vine.
Virescent, *Viridescent*, greenish; turning green.
Virgate, wand-shape; as a long, straight, and slender twig.
Viscous, *Viscid*, having a glutinous surface.
Vitta (plural *vittæ*), the oil-tubes of the fruit of Umbelliferæ.
Vitellæne, yellow, of the hue of yolk of egg.
Viviparous, sprouting or germinating while attached to the parent plant.
Volute, twining; as the stem of Hops and Beans, 39.
Volute, rolled up in any way.
- Wavy*, the surface or margin alternately convex and concave, 55.
Waxy, resembling beeswax in texture or appearance.
Wedge-shaped, broad above, tapering by straight lines to a narrow base, 53.
Wheel-shaped, 89.
Whorl, an arrangement of leaves, &c., in circles around the stem.
Whorled, arranged in whorls, 68.
Wing, any membranous expansion. *Wings* of papilionaceous flowers, 92.
Winged, furnished with a wing; as the fruit of Ash and Elm, fig. 300, 301.
Wood, 133, 142. *Woody*, of the texture or consisting of wood.
Woody Fibre, or *Wood-Cells*, 134.
Woolly, clothed with long and entangled soft hairs.
Work in plants, 149, 155.

Xanthos, Greek for yellow, used in compounds; as *Xanthocarpus*, yellow-fruited.

Zygomorphous, said of a flower which can be bisected only in one plane into similar halves.

MANUAL OF THE BOTANY
OF THE
ROCKY MOUNTAIN REGION.

MANUAL OF THE BOTANY

(PHANOGAMIA AND PTERIDOPHYTES)

OF THE

ROCKY MOUNTAIN REGION,

FROM NEW MEXICO TO THE BRITISH
BOUNDARY.

BY

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NEW YORK ··· CINCINNATI ··· CHICAGO
AMERICAN BOOK COMPANY

Copyright, 1885,
BY JOHN M. JOULES.

Printed by
William Ivison
New York, U. S. A.

P R E F A C E.

THIS manual is intended to do for its own range what has been for a long time so admirably done for the Northeastern States by Dr. Gray's Manual. About ten years ago it was the writer's privilege to assist Professor Porter in the preparation of the *Synopsis of the Flora of Colorado*, a first attempt to bring together in convenient shape, for a restricted region, the scattered material of our Western collectors. The demand even then for a book by no means complete or conveniently arranged was unexpected, and in the wonderful development of the decade since then lies the confidence that a more convenient book covering a greater range will be welcome to many. The difficulties attending the naming of Western plants, owing to the fact that descriptions are scattered through numerous and often inaccessible publications, can only be appreciated by those who have attempted it. From this fact, a great stimulus to the study of systematic botany has been lacking, collectors have been almost entirely professional, and a thousand possible streams of information have been reduced to a score.

West of the Mississippi Valley prairie region, which is but the continuation of more eastern conditions, there are three well-defined floras. One is that of the Pacific slope; another is Mexican in character, extending from the Great Basin to Arizona, New Mexico, Western Texas, and southward into Mexico; the third is the Rocky Mountain region, extending eastward across the plains to the prairies.

The first region is well provided for in the two volumes of the *Botany of California*. The second, in the Great Basin, has

Sereno Watson's *Botany of the 40th Parallel*, and in its Arizona and New Mexican section, Dr. Rothrock's *Botany of the Wheeler Survey*. The third region is that which this manual attempts to provide for, its only predecessor being the *Synopsis of the Flora of Colorado*, already referred to. Essentially, therefore, the range includes Colorado, Wyoming, Montana, Western Dakota, Western Nebraska, and Western Kansas, the hundredth meridian representing very nearly the eastern boundary. While this is true, the larger part of contiguous floras also will be found described, so that the western part of the Indian Territory, Northwestern Texas, Northern New Mexico and Arizona, and Eastern Utah and Idaho, may be included for all except their own peculiar plants. In Utah, our range is naturally carried westward by the Uinta and Wahsatch Mountains, whose plants are intended to be included.

This edition only claims to be a compilation, an orderly arrangement and sifting of scattered material. The chief reason is, that first editions are necessarily incomplete, and that materials for the satisfactory presentation of a flora most quickly come from the provocation of an incomplete edition. The author will therefore esteem it the surest evidence of the usefulness of this book, if in the abundance of corrections called forth a more complete edition may be attempted at an early day.

It is unnecessary to give all the sources of descriptions and information, as it would simply be a catalogue of the very numerous contributions to western botany. The professional botanist will notice that descriptions have been chiefly obtained from the *Botany of California*, *Botany of King's Expedition*, and Eaton's *Ferns of North America*, all constantly influenced by Gray's *Manual*; and that the presentation of Gamopetalæ is little more than a culling from Dr. Gray's recent volumes of the *Synoptical Flora of North America*. As in most cases descriptions and synoptical arrangement could be obtained from the writings of Dr. Gray, Mr. Watson, and Professor Eaton, little more is attempted in this edition than to adapt these descriptions to the spirit of the work with as little change as

possible. To Dr. Gray is due, not only the thought which grew into this book, but also a constant encouragement and patient criticism which have developed anything of merit it possesses. Mr. Watson has also responded generously to every demand made upon him; while to Messrs. M. S. Bebb and L. H. Bailey, Jr. is due the relief of some original work, the former being our well-known authority in the difficult genus *Salix*, and the latter an ardent and most successful student of the perplexing genus *Carex*. At the time of his death, Dr. George Engelmann had in preparation the groups with which his name is so closely connected, and their presentation shows the lack of his master hand.

In general, the ordinal sequence adopted by Bentham and Hooker's *Genera Plantarum* has been followed, but Gymnosperms have been transferred to the end of Phænogams, and Monocotyledons and Dicotyledons subordinated to Angiosperms. This change has been made simply because it better expresses relationships which have long been recognized. The term "Cryptogam" has been discarded as the correlative of Phænogam, and Pteridophyta (Vascular Cryptogams) is used as the name of the second great series of plants. The orders and ordinal sequence of the Pteridophyta are thought best to express their relationships.

Introduced plants are placed in foot-notes, that they may be separated as far as possible from our native plants, and their relation to the flora thus emphasized.

To save space, there is no attempt to give any but the most important references and synonymy, while geographical range is reduced to its lowest terms, and collectors' names almost entirely omitted. For the most part no characters have been repeated, and the student is warned that generic characters especially must be sought for through analytical keys. The professional botanist will note a glaring inconsistency in this respect, the genera of some families being grouped by means of a few very salient characters, while those of others are presented with almost full descriptions, only certain supplementary statements being left to head the descriptions of

species. It is sufficient to say that the two methods hold the relation to each other of former and latter in the preparation of this book.

In groups of species certain contrasting characters have been italicized, according to the method of Gray's Manual. This is done to facilitate the work of the student, but with the mental reservation that its abuse may more than offset its advantage. Ten years' experience as a teacher has shown that the ordinary student will fix his attention upon the italicized characters to the neglect of the description as a whole. The student is here warned that the specific descriptions in this book have been so much reduced that no unimportant characters are intended to be given.

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January 1, 1885.

ANALYTICAL KEY TO THE ORDERS.

SERIES I. PHÆNOGAMIA or FLOWERING PLANTS. Those
with flowers and seeds.

CLASS I. ANGIOSPERMÆ. Pistil a closed ovary containing the
ovules.

SUBCLASS I. DICOTYLEDONS. Embryo with two cotyledons.
Leaves netted-veined. Flowers usually 4 or 5-merous.

DIVISION I. POLYPETALÆ. Calyx and corolla both present: the
latter of separate petals.

A. *Stamens numerous, at least more than 10, and more than twice the petals.*

1. *Stamens on the receptacle, free from the ovary and calyx.*

Pistils few to many distinct carpels. RANUNCULACEÆ, 1

Pistil compound: cells, placentæ, or stigmas more than one.

Petals more numerous than sepals,

Very numerous, small and persistent: aquatic. NYMPHÆACEÆ, 3

Twice as many (4 or 6), and both usually caducous. PAPAVERACEÆ, 4

Five to sixteen: sepals persistent. PORTULACACEÆ, 12

Petals same number as sepals,

Four, and both deciduous. CAPPARIDACEÆ, 7

Five, and the calyx persistent.

Sepals valvate in the bud: stamens monadelphous. MALVACEÆ, 15

Sepals imbricated in the bud: leaves entire and
pellucid-punctate. HYPERICACEÆ, 14

2. *Stamens on the (free or adnate) calyx.*

Leafless mostly prickly fleshy plants: ovary 1-celled. CACTACEÆ, 34

Leafy fleshy plants: ovary 3 or more-celled. FICOIDEÆ, 35

Leafy fleshy herbs: ovary 1-celled. PORTULACACEÆ, 12

Not fleshy.

Leaves opposite, simple: sepals and petals 4 or 5. SAXIFRAGACEÆ, 27

Leaves alternate, with stipules. ROSACEÆ, 26

Leaves alternate, without stipules, rough. LOASACEÆ, 32

B. *Stamens 10 or less, or at most not more than twice the petals.***1.** *Ovary or ovaries superior or mainly so.** *Pistils more than one, and distinct.*Pistils same number as petals and as sepals: leaves fleshy. **CRASSULACEÆ, 98**

Pistils not same number as petals or sepals.

Stamens on the receptacle. **RANUNCULACEÆ, 1**

Stamens on the calyx.

Stipules persistent: leaves alternate. **ROSACEÆ, 26**Stipules none or indistinct. **SAXIFRAGACEÆ, 27*** * *Pistil only one.*+ *Pistil simple, as shown by the single style, stigma, and cell.*Anthers opening by uplifted valves or transversely. . . **BERBERIDACEÆ, 2**

Anthers opening lengthwise or at the top.

Flowers irregular, or leaves twice pinnate: fruit a legume. **LEGUMINOSÆ, 25**Flowers irregular: leaves simple. **POLYGALACEÆ, 9**

Flowers regular: leaves mostly stipulate: fruit a drupe

or akene. **ROSACEÆ, 26**+ + *Pistil compound, as shown by the number of cells or placenta, styles or stigmas.*

Ovary 1-celled, with (2 to 4, rarely more) parietal placenta.

Petals (long-clawed) and teeth of long-tubular calyx 4

or 5. **FRANKENIACEÆ, 10**

Petals and sepals or lobes of the cleft calyx 5.

Corolla irregular: lower petal spurred. **VIOLACEÆ, 8**Corolla regular or nearly so: styles or stigmas entire. **SAXIFRAGACEÆ, 27**Petals 4: bract-like sepals 2: flower irregular. . . . **FUMARIACEÆ, 5**Petals and sepals each 4: stamens 6. **CAPPARIDACEÆ, 7**

Ovary and pod 2-celled: 2 parietal placenta: stamens tetra-

dynamous. **CRUCIFERÆ, 6**

Ovary and capsule 1-celled, several to many-seeded on a central placenta,

Truly so; the partitions wanting or very incomplete.

Sepals 2: leaves often alternate. **PORTULACACEÆ, 12**Sepals or calyx-lobes 5 or 4: leaves all opposite. **CARYOPHYLLACEÆ, 11**

Apparently so; the partitions at length vanishing.

Stipules between the opposite leaves. **ELATINACEÆ, 13**No stipules. **LYTHRACEÆ, 30**

Ovary and fruit 1-celled, with a single seed on a stalk from the base.

Shrubs: styles or stigmas 3: fruit drupe-like. **ANACARDIACEÆ, 24**Herbs: style at most 2-cleft: fruit a utricle. **ILLECEBRACEÆ, 63**

Ovary more than 1-celled: seeds attached to the axis, or base, or summit.

Flowers very irregular: ovary 2-celled: cells 1-seeded. **POLYGALACEÆ, 9**

Flowers regular or nearly so.

No green foliage. **Monotropeæ, etc., in ERICACEÆ, 45**Foliage pellucid-punctate: strong-scented shrubs. . . **RUTACEÆ, 19**

Foliage not pellucid-punctate.

Anthers opening by terminal chinks or pores. . . . **ERICACEÆ, 45**

Anthems opening lengthwise.

Stamens as many as the petals, and opposite them.

Calyx-lobes valvate in the bud. RHAMNACEÆ, 21

Calyx-lobes small or obsolete : petals valvate. VITACEÆ, 22

Stamens when just as many as petals alternate with them.

Strong-scented shrub : leaves opposite, 2-foliate. ZYGOPHYLLACEÆ, 17

Strong-scented herbs : leaves lobed or compound. GERANIACEÆ, 18

Herbs, not strong-scented.

Ovules 1 to 4 in each cell.

Leaves all simple and entire. LINACEÆ, 16

Leaves all opposite, compound, and leaflets entire. ZYGOPHYLLACEÆ, 17

Leaves alternate or opposite, the latter with divisions or leaflets not entire. GERANIACEÆ, 18

Ovules numerous.

Stamens on the calyx : styles 2 or 3. SAXIFRAGACEÆ, 27

Stamens on the receptacle : leaves opposite, simple.

Cells of the ovary as many as the sepals, 2 or 5. ELATINACEÆ, 13

Cells fewer than the sepals, 3. Mollugo, in FICOIDEÆ, 35

Shrubs or trees with opposite simple leaves.

Leaves pinnately veined, not lobed. CELASTRACEÆ, 20

Leaves palmately veined, lobed. SAPINDACEÆ, 23

Shrubs or trees with opposite compound leaves.

Stamens 4 to 8. SAPINDACEÆ, 23

Stamens 2 or rarely 3. OLEACEÆ, 47

2. *Ovary and fruit inferior or mainly so.*

Tendril-bearing herbs : flowers monœcious or diœcious. CUCURBITACEÆ, 33

Aquatic herbs : flowers diœcious or monandrous. HALORAGACEÆ, 29

Shrubs or herbs, not tendril-bearing nor diœcious, nor umbelliferous.

Stamens as many as the small or unguiculate petals and opposite them. RHAMNACEÆ, 21

Stamens if of the number of the petals alternate with them.

Styles 2 to 5, distinct or united below.

Fruit a few-seeded pome. ROSACEÆ, 26

Fruit a many-seeded capsule. SAXIFRAGACEÆ, 27

Fruit a 1-celled many-seeded berry. Ribes, in SAXIFRAGACEÆ, 27

Style 1, undivided : stigmas 1 to 4.

Flowers in cymes or a glomerate cluster. CORNACEÆ, 38

Flowers racemose, spicate, or axillary.

Ovary 1-celled : herbage scabrous. LOASACEÆ, 32

Ovary 2 to 5-, mostly 4-celled. ONAGRACEÆ, 31

Herbs : flowers in umbels : styles 2 : fruit dry. UMBELLIFERÆ, 36

Herbs or shrubs : flowers in umbels : styles 4 or 5 : fruit

berry-like. ARALIACEÆ, 37

DIVISION II. GAMOPETALÆ. Petals more or less united into one piece.

A. *Ovary inferior, or mostly so.*

- Stamens more numerous than the lobes of the corolla, 8 or 10, distinct. ERICACEÆ, 45
- Stamens as many as the lobes of the corolla, 5 (or 4), syngenesious.
- Flowers in an involucrate head. COMPOSITÆ, 42
- Flowers separate, racemose or spicate. LOBELIACEÆ, 43
- Stamens as many as the corolla lobes (at least 4), distinct,
- Nearly or quite free from the corolla: leaves alternate:
- no stipules. CAMPANULACEÆ, 44
- Inserted on the corolla: leaves opposite or whorled,
- With stipules, or else in whorls, quite entire. . . . RUBIACEÆ, 40
- Without stipules, opposite. CAPRIFOLIACEÆ, 39
- Stamens only 3, fewer than the lobes of the corolla.
- Leaves opposite: stamens distinct. VALERIANACEÆ, 41
- Leaves alternate: stamens often united. CUCURBITACEÆ, 33

B. *Ovary superior (free), or mostly so.*

1. *Stamens more numerous than the lobes of the corolla.*

- Pistil single and simple: leaves compound. LEGUMINOSÆ, 25
- Pistil compound, with one undivided style. ERICACEÆ, 45

2. *Stamens as many as the lobes of the corolla and opposite them.*

- Style 1: ovary and capsule several to many-seeded. . . . PRIMULACEÆ, 46

3. *Stamens as many as the lobes of the corolla, and alternate with them, or fewer.*

** No green herbage.*

- Corolla regular: stamens free: seeds very many and minute. Monotropææ, in ERICACEÆ, 45
- Corolla regular: stamens on the tube: fruit 2-celled.
- Cuscuta, in CONVULVULACEÆ, 54
- Corolla irregular: stamens didynamous: capsule 1-celled, many-seeded. OROBANCHACEÆ, 57

** * With ordinary green herbage.*

+ Corolla regular or nearly so: stamens not didynamous.

- Corolla scarious and veinless: stemless herbs. . . . PLANTAGINACEÆ, 61
- Corolla more or less veiny.
- Stamens 2 or 3: parts of the corolla 4 or 5. OLEACEÆ, 47
- Stamens 5 (or 4), as many as the corolla-lobes.
- Pollen in solid waxy masses: fruit a pair of follicles. ASCLEPIADACEÆ, 49
- Pollen powdery.
- Ovaries 2: fruit a pair of follicles. APOCYNACEÆ, 48

- Ovary 4-lobed, forming 4 separate or separable seed-like nutlets. BORRAGINACEÆ, 53
- Ovary single and entire.
- Style 3-cleft at apex : capsule 3-celled : corolla convolute. POLEMONIACEÆ, 51
- Styles or stigmas 2 or 1.
- Ovules and seeds at most 4, large, with large embryo and little or no albumen : peduncles axillary. CONVULVULACEÆ, 54
- Ovules few or numerous : embryo small, in albumen.
- Leaves all opposite or whorled and entire : capsule 1-celled : corolla convolute. GENTIANACEÆ, 50
- Leaves various, mainly alternate.
- Styles 2 (or 1 and 2-cleft) : capsule 1 to 2-celled. HYDROPHYLLACEÆ, 52
- Style 1 : stigma usually 1 : capsule or berry 2-celled, rarely more. SOLANACEÆ, 55
- See also *Limosella*, in SCROPHULARIACEÆ, 56
- ← ← *Corolla irregular : stamens (with anthers) 4 and didynamous, or 2 : style 1.*
- Ovary and capsule 2-celled : seeds small, mostly indefinite. SCROPHULARIACEÆ, 56
- Ovary and capsule 1-celled, with many-seeded placentæ in the axis. LENTIBULARIACEÆ, 58
- Ovary 4-parted, in fruit as many seed-like nutlets. LABIATÆ, 60
- Ovary undivided : fruit splitting into 2 or 4 one-seeded nutlets. VERBENACEÆ, 59

DIVISION III. APETALÆ. Corolla (and sometimes calyx) wanting.

A. Flowers not in aments.

1. Ovary and fruit superior, 1-celled and 1-ovuled, or carpels distinct if more than one.

Stipules sheathing the stem at the nodes. POLYGONACEÆ, 66

Stipules not sheathing the stem or none.

Shrubs or trees.

Leaves alternate : flowers perfect : fruit a tailed akene.

Cercocarpus, in ROSACEÆ, 26

Leaves alternate : flowers unisexual : fruit a utricle. CHENOPODIACEÆ, 65

Leaves opposite.

Fruit an akene : leaves small and narrow. Coleogyne, in ROSACEÆ, 26

Fruit a simple samara : leaves pinnate. Fraxinus, in OLEACEÆ, 47

Herbaceous, or sometimes woody at base.

Fruit a utricle : seed lenticular : embryo annular or spiral.

Flowers with scarious persistent sepals and bracts : no

stipules. AMARANTACEÆ, 64

- Bracts herbaceous or none: no stipules. CHENOPODIACEÆ, 65
 Stipules scarious. ILLECEBRACEÆ, 63
 Fruit a more or less triangular akene: embryo curved.
 Flowers perfect, on jointed pedicels, involucrate. POLYGONACEÆ, 66
 Akene not triangular: embryo straight.
 Flowers unisexual: filaments incurved in bud: leaves
 simple. URTICACEÆ, 73
 Submerged: flowers axillary, naked: leaves sessile,
 filiformly dissected. CERATOPHYLLACEÆ, 72
 Carpels several and distinct, 1 to several-ovuled: calyx
 usually corolla-like. RANUNCULACEÆ, 1
- 2.** *As in (1), but ovary and fruit enclosed by the calyx and apparently inferior.*
 Shrubs, with scurfy opposite entire leaves: flowers diœcious:
 fruit baccate. ELÆAGNACEÆ, 67
 Herbs: calyx corolla-like: fruit an akene.
 Leaves simple, opposite, entire, without stipules: flowers
 involucrate. NYCTAGINACEÆ, 62
 Leaves compound, alternate, stipulate. ROSACEÆ, 26
- 3.** *Ovary and fruit superior, of 2 or more carpels.*
 Fruit 2 to 4-celled, usually lobed: cells 1 to 2-ovuled.
 Capsule 3-celled, 3-lobed: juice milky: mostly herbaceous. EUPHORBIACEÆ, 70
 Fruit 4-celled, 4-lobed, compressed, indehiscent: styles 2:
 small aquatic, with opposite entire leaves. CALLITRICHACEÆ, 71
 Fruit fleshy, 3-celled, 3-lobed: shrubs with alternate simple
 leaves. RHAMNACEÆ, 21
 Fruit a double samara: trees with opposite pinnate leaves. SAPINDACEÆ, 23
 Cruciferous herb: pod small, obcompressed. Lepidium, in CRUCIFERÆ, 6
 Fruit capsular, 1-celled or more, several-ovuled: low herbs
 with opposite leaves.
 Capsule 3 to 5-celled: succulent. FICOIDEÆ, 35
 Capsule 1-celled: placentæ central.
 Style and stigma 1: stamens alternate with the sepals. Glaux, in PRIMULACEÆ, 46
 Styles or stigmas 3 or more: stamens opposite the
 sepals. CARYOPHYLLACEÆ, 11
- 4.** *Ovary and fruit inferior.*
 Fruit many-seeded: capsule ($\frac{1}{2}$ inferior) 1-celled: leaves
 cordate. SAXIFRAGACEÆ, 27
 Fruit mostly 1-seeded.
 Flowers perfect: fruit nut-like: herbs with alternate entire
 leaves. SANTALACEÆ, 69
 Dioecious parasites on trees, with opposite leaves and jointed
 stems: berry with glutinous pulp. LORANTHACEÆ, 68
 Aquatic herbs, with opposite or verticillate leaves. HALORAGACEÆ, 29

B. *Flowers unisexual, at least the staminate in aments. Trees or shrubs with alternate leaves.*

Monœcious: male flowers in aments; female solitary or few:

ovary inferior: leaves simple, with caducous stipules.

Anthers 2-celled: nut in a cup-like or spiny involucre. CUPULIFERÆ, 74

Anther cells separate: nut in a foliaceous or tubular invo-

lucre. Corylus in CUPULIFERÆ, 74

Monœcious or diœcious, flowers all in aments: ovary superior.

Fruit a 1-seeded nutlet: bracts thickened and rigid in fruit:

nut winged or angled. Betuleæ, in CUPULIFERÆ, 74

Fruit a many-seeded capsule: diœcious: bracts herbaceous:

seeds comose. SALICACEÆ, 75

SUBCLASS II. MONOCOTYLEDONS. Embryo with a single cotyledon. Leaves mostly parallel-veined. Flowers usually 3-merous, never in fives. Mostly herbaceous.

A. *Ovary inferior: perianth conspicuous, colored: terrestrial: flowers perfect.*

Flowers irregular: stamens and style coherent; anthers 1 or 2:

leaves alternate, sheathing. ORCHIDACEÆ, 76

Flowers regular: stamens 3, perigynous: leaves equitant. IRIDACEÆ, 77

Flowers regular: stamens 6, perigynous: leaves not equitant.

AMARYLLIDACEÆ, 78

B. *Ovary superior or nearly so: perianth regular or none.*

Carpels united into a compound ovary: perianth corolla-like,

rarely partly herbaceous: terrestrial plants.

Woody climber, with tendrils: anthers 1-celled. SMILACEÆ, 80

Herbs: anthers 2-celled.

Perianth mostly of similarly colored lobes or divisions:

stems from a bulb, corm, or rhizome. LILIACEÆ, 79

Perianth of 3 green sepals, and 3 ephemeral deliquescent

petals: stems from fibrous roots. COMMELINACEÆ, 81

Carpels distinct or solitary: aquatic or marsh herbs.

Perianth none: seed albuminous: fruit utricular or nut-like.

Flowers monœcious in heads or on a crowded spadix:

leaves linear. TYPHACEÆ, 83

Small floating disk-like plants. LEMNACEÆ, 84

Perianth herbaceous, petaloid, or none: albumen none.

Carpels few: perianth none or in fertile flowers herbaceous.

NAIADACEÆ, 86

Carpels numerous in a whorl or head: 3 sepals herbaceous,

3 petaloid. ALISMACEÆ, 85

Perianth of 6 similar glumaceous segments: capsule 3-valved.

Rushes or sedge-like. JUNCACEÆ, 82

Flowers in the axils of scales or glumes, spicate, without evi-

dent perianth. Stems solid: sheaths closed: scales single:

anthers basifixed. CYPERACEÆ, 87

Culms hollow, terete: sheaths split: glumes in pairs: anthers

versatile. GRAMINEÆ, 88

CLASS II. GYMNOSPERMÆ. Ovules naked upon a scale or bract, or within open integuments. Monœcious or diœcious trees or shrubs.

Male flowers in aments: female subsolitary, the ovule within a double integument with small terminal orifice: nearly naked diœcious shrubs. GNETACEÆ, 89

Female flowers in aments, becoming dry cones or berry-like: ovules naked at the base of a scale: from shrubs to trees of the largest size; with needle or scale-like leaves. . . . CONIFERÆ, 90

SERIES II. PTERIDOPHYTA, or the FERN GROUP. Plants without true flowers or seeds, but reproducing by spores; and with a distinct axis containing fibro-vascular bundles.

Stems solid, leafy: sporangia in the axils of simple leaves or bracts.

Leaves long and grass-like from a corm-like trunk: spores of two kinds ISOETÆ, 91

Small leaves imbricated upon a moss-like stem: sporangia in terminal spikes.

Spores of two kinds: leaves with ligules. . . . SELAGINELLÆ, 92

Spores of one kind: leaves without ligules. . . . LYCOPODIACEÆ, 93

Stems solid, subterranean, bearing long-petioled often compounded leaves (fronds).

Aquatics: leaves circinate developed: sporangia in fruits borne on the stem or petioles. . . . RHIZOCARPEÆ, 94

Terrestrial: leaves erect in veneration: sporangia in special spikes or panicles. . . . OPHIOGLOSSACEÆ, 95

Terrestrial: leaves circinate in veneration: sporangia on the under surface or margins of the leaves. . . . FILICES, 96

Stems hollow, jointed, and striate: leaves reduced to a toothed sheath at the joints: sporangia in a terminal spike or cone. EQUISETACEÆ, 97

BOTANY

OF THE

ROCKY MOUNTAINS.

SERIES I.

PHÆNOGAMIA OR FLOWERING PLANTS.

PLANTS bearing true flowers, that is, having stamens and pistils and producing seeds which contain an embryo.

CLASS I. ANGIOSPERMÆ.

Pistil consisting of a closed ovary which contains the ovules and forms the fruit.

SUBCLASS I. DICOTYLEDONS.

Embryo with a pair of opposite cotyledons. Leaves netted-veined. Flowers usually 4- or 5-merous.

DIVISION I. POLYPETALÆ.

Perianth consisting usually of both calyx and corolla; the petals not united with each other, sometimes wanting.

ORDER 1. **RANUNCULACEÆ.** (CROWFOOT FAMILY.)

Herbaceous or somewhat shrubby plants with very diverse characters; generally distinguished by the few or numerous sepals, petals, stamens, and pistils being distinct and free. The flowers are regular or irregular. The sepals are very commonly petal-like, and the petals are often wanting. The fruits are akenes, dry pods, or berries. The leaves vary from simple to much compounded, usually on the palmately veined type, with petioles dilated at base, and without stipules.

Tribe I. Sepals valvate, petal-like. Petals none or very small. The fruit a head of akenes, tailed with feathery or hairy or rarely naked styles. Leaves opposite.

1. **Clematis.** Half-woody, climbing by the petioles, or erect and herbaceous.

Tribe II. Sepals imbricate, often petal-like. The fruit a head or spike of akenes.

* Petals none. Akenes in a head.

2. **Anemone.** Sepals indefinite in number. Leaves on the stem opposite or whorled on or below one-flowered peduncles.

3. **Thalictrum.** Flowers mostly dioecious, panicled. Leaves alternate.

* * Petals slender. Akenes numerous in a long slender spike.

4. **Myosurus.** Flowers solitary on a scape. Sepals spurred at base.

* * * Petals generally broad and conspicuous. Akenes numerous in a head.

5. **Ranunculus.** Petals with a little pit or scale at the base inside. The akene differs from all others of the order in having the ovule erect.

Tribe III. Sepals imbricate. Petals none, small, or irregular. Fruit a pod or berry. Leaves alternate.

* Fruit consisting of pods (follicles), 1 to 15 in number.

+ Flowers regular. Pods 5 to 15.

6. **Caltha.** Sepals petal-like. Petals none. Pods 5 to 12. Leaves simple.

7. **Trollius.** Petals many, minute and stamen-like, hollowed near the base. Pods 8 to 15. Leaves palmately divided.

8. **Aquilegia.** Sepals deciduous. Petals 5, all spurred backward. Pods 5. Leaves ternately compound.

+ + Flowers irregular. Pods 1 to 5.

9. **Delphinium.** Upper sepal produced backward into a spur.

10. **Aconitum.** Upper sepal arched into a hood.

* * Fruit a berry of one carpel.

11. **Actæa.** Sepals caducous. Petals small. Leaves ternately compound. The flowers are in a single raceme.

1. **CLEMATIS, L.** VIRGIN'S-BOWER.

Sepals 4 or rarely more. A genus which is readily recognized by its few petal-like valvate sepals, and long-tailed akenes.

* *Petals none.*

+ *Stem erect.*

1. **C. Fremontii**, Watson. Stems *stout, clustered*, 6 to 12 inches high, leafy and usually branched, more or less villous-tomentose, especially at the nodes: *leaves simple*, 3 to 4 pairs, *thickish* and with the veinlets conspicuously

reticulated, broadly ovate, entire or few-toothed: flowers terminal, nodding; the thick purple sepals an inch long, tomentose upon the margin, recurved at the tip: akenes silky; the tails less than an inch long, naked above, silky at base. — Proc. Am. Acad. x. 339. This species was discovered by Fremont, but with locality unknown. It has been rediscovered in Kansas by Dr. Louis Watson and others, and is the western representative of *C. ochroleuca*.

2. *C. Douglasii*, Hook. Stem simple or branching, more or less villous, woolly at the joints: leaves from pinnate to 2 or 3-pinnatifid; the leaflets linear or linear-lanceolate: sepals thick, deep purple within, paler externally, woolly at the apex, and spreading: akenes silky; the tails an inch or more in length. — From Colorado to Washington.

Var. *Scottii*. A form with leaflets ovate or lanceolate, and tips of sepals more reflexed and probably less woolly. — *C. Scottii*, Porter, Fl. Col. 1. Colorado and northward.

+ + Stem climbing, more or less woody.

3. *C. ligusticifolia*, Nutt. Nearly glabrous: stems sometimes very long: leaves pinnate and ternate, mostly 5-foliolate; the leaflets oblong, acute, mostly somewhat lanceolate-cuneate, incisely toothed and trifid: flowers white, in paniculate corymbs, diœcious: sepals thin, equalling the stamens. — Torr. & Gray, Fl. i. 9. From New Mexico to the Saskatchewan and Oregon, and also in California. Climbing over bushes and producing a great abundance of white flowers.

* * Some of the outer filaments enlarging to small petals: stems woody.

4. *C. alpina*, Mill., var. *occidentalis*, Gray. Trailing, nearly glabrous: leaves bitermately divided; segments ovate or oblong-lanceolate, acuminate, frequently 3-lobed, irregularly toothed: sepals purplish-blue, thin: anther-bearing petals linear: akenes glabrous. — Powell's Geol. Black Hills, p. 531. The *C. alpina*, var. *Ochotensis*, of the various Western reports. From New Mexico to the Wasatch and Teton Mountains.

5. *C. verticillaris*, DC. Climbing: leaves trifoliolate, with leaflets about as in the last, but oftener entire: the flowers 2 to 3 inches across, with the thin bluish-purple sepals widely spreading. — From California to Maine, and from the Wasatch and Uinta Mountains to British America.

2. ANEMONE, L. WIND-FLOWER.

Sepals colored and petal-like. Style short and stigma lateral. Akenes compressed, pointed or ending in long feathery awns. — Perennial herbs with radical leaves.

* Akenes with long bearded tails.

1. *A. patens*, L., var. *Nuttalliana*, Gray. Villous with long silky hairs: flower erect, developed before the leaves; which are ternately divided, the lateral divisions 2-parted, the middle one stalked and 3-parted, the segments deeply once or twice cleft into narrowly linear and acute lobes: sepals 5 to 7, purplish or whitish. — From the mountains eastward into Illinois and Wisconsin.

* * *Akenes without tails.*

+ *Akenes very numerous in a close head, densely villous.*

++ *Low (3 to 12 inches high) or slender plants, with simple stems.*

2. **A. decapetala**, L. Stem 3 to 6 inches high from a round tuber: root-leaves once or twice 3-parted or cleft: *involucre* (mostly sessile and far below the flower) 3-parted, the wedge-shaped divisions 3-cleft: *sepals* 10 to 20, oblong-linear, purple or whitish: *head of fruit* oblong.—*A. Caroliniana*, Walt. From Colorado to Arizona and New Mexico, and across the continent to the Carolinas.

3. **A. parviflora**, Michx. Stem 3 to 12 inches high from a slender root-stock: root-leaves 3-parted, their broadly wedge-shaped divisions crenate-incised or lobed: *involucre* 2 to 3-leaved, distant from the flower: *sepals* 5 or 6, oval, white: *head of fruit* globular.—Mountains of Colorado, and northward to the Arctic Sea.

++ *Taller (6 inches to 2 feet), commonly branching above or producing two or more peduncles: sepals 5 to 8, silky or downy beneath, oval or oblong.*

4. **A. multifida**, Poir. Silky-hairy (6 to 12 inches high): principal involucre 2 to 3-leaved, bearing one naked and one or two 2-leaved peduncles; leaves of the secondary involucre short-petioled, similar to the root-leaves, twice or thrice 3-parted and cleft, their divisions linear: *sepals* red, sometimes greenish-yellow or whitish: *head of fruit* spherical or oval.—Across the continent in northern latitudes, and southward in the mountains through Colorado.

5. **A. cylindrica**, Gray. Taller, and clothed with silky hairs: flowers 2 to 6, on very long and upright naked peduncles: leaves of the involucre long-petioled, twice or thrice as many as the flower-stalks, 3-divided, their divisions wedge-shaped, the lateral 2-parted, the middle one 3-cleft, lobes cut and toothed at the apex: *sepals* greenish-white: *head of fruit* cylindrical.—From Colorado to Bitter Root valley and thence eastward across the continent.

+ + *Akenes fewer, pubescent only.*

6. **A. dichotoma**, L. Hairy, rather low: *involucres* sessile: the primary ones 3-leaved, bearing a naked peduncle, and soon a pair of branches or peduncles with a 2-leaved involucre at the middle, which branch similarly in turn; their leaves broadly wedge-shaped, 3-cleft, cut and toothed: radical leaves 5 to 7-parted or cleft: *sepals* 5, obovate, white: *carpels* orbicular.—*A. Pennsylvanica*, L. Common on the foothills of Colorado, northward and eastward.

7. **A. nemorosa**, L. Smooth or somewhat villous: stem perfectly simple from a filiform rootstock, slender, leafless, except the *involucre* of 3 long-petioled trifoliate leaves; their leaflets wedge-shaped or oblong, toothed or cut, or the lateral ones 2-parted; a similar radical leaf in sterile plants solitary from the rootstock: *sepals* 4 to 7, oval, white or pinkish: *carpels* oblong, with a hooked beak.—Northern United States and British America.

+ + + *Akenes glabrous.*

8. **A. narcissiflora**, L. Villous: leaves palmately 3 to 5-parted; segments cuneiform, incisely many-cleft, lobes linear: involucre somewhat similar, sessile, leaflets 3 to 5-cleft: pedicels several, umbelled, leafless,

1-flowered: flowers white: carpels roundish-oval. — Alpine. In Colorado at 13,000 feet altitude, and thence through British America.

3. THALICTRUM, L. MEADOW-RUE.

Sepals 4 to 7, either greenish or petal-like. Pistils 4 to 15. — Perennial herbs with leaves 2 or 3 times ternately compound, the leaflets stalked. Flowers in corymbs or panicles. The dioecious species are easily recognized by combining that character with the much compounded leaves, and all of our species can be distinguished from *Anemone* by their alternate leaves and inconspicuous flowers.

* *Flowers perfect.*

1. **T. alpinum**, L. Stem simple, 2 to 8 inches high, slightly pubescent: leaves mostly radical: leaflets roundish, about $\frac{1}{2}$ inch long, somewhat lobed, crenately toothed: flowers nodding in a simple raceme: stigmas thick and pubescent: carpels ovate, sessile. — Colorado and northward throughout British America.

2. **T. sparsiflorum**, Turcz. Stem 1 to 3 feet high: upper leaves sessile: flowers on long pedicels in a loose panicle: filaments clavate: carpels strongly compressed, semi-obovate, short-stipitate, thrice shorter than the persistent style. — Subalpine. Colorado and far northward; also in California.

* * *Flowers diœcious.*

3. **T. Cornuti**, L. Stem 2 to 4 feet high: stem-leaves sessile (without general petiole) or nearly so; leaflets roundish or oblong and more or less 3-lobed, pale and usually minutely pubescent beneath, the margin mostly revolute and the veining conspicuous: panicles compound: flowers white, greenish, and purplish: filaments thickened upwards. — Possibly includes *T. purpurascens*, L. Colorado, and in the Atlantic States.

4. **T. Fendleri**, Engelm. Rather low and slender, occasionally somewhat pubescent: leaves petioled or the uppermost sessile; leaflets usually small: flowers in an open panicle: anthers setosely acuminate: akenes slightly glandular-puberulent, oblong to ovate, acuminate, 2 or 3 lines long. — Pl. Fendl. 5. Colorado and New Mexico, and westward to Utah and Nevada.

5. **T. occidentale**, Gray. Like the last, but stouter, the leaflets larger and akenes few in a head (1 to 6), narrowly oblong (3 or 4 lines long), and narrowed at each end. — Proc. Am. Acad. viii. 372. From California to Washington, and extending into Western Montana.

4. MYOSURUS, L. MOUSETAIL.

Sepals 5. Petals 5, linear, on a slender claw with a pit at its summit. Stamens 5 to 20. — Very small annual herbs, with a tuft of linear or spatulate entire radical leaves, and solitary flowers on simple scapes. The long slender spike of akenes and linear radical leaves give the plant the appearance of a diminutive plantain.

1. **M. minimus**, L. Scapes 2 to 6 inches high: leaves usually shorter: akenes blunt, on slender spikes 1 or 2 inches long. — From California through Colorado to the Ohio Valley.

M. aristatus, Benth., may be found where our boundary touches Utah and Southern Idaho. It is characterized by its akenes being beaked with a divergent persistent style nearly equalling the akene.

5. RANUNCULUS, L. CROWFOOT. BUTTERCUP.

Sepals usually 5. Petals 3 to 15. Akenes mostly flattened, pointed. — Mostly perennial herbs. Flowers either solitary or somewhat corymbed, usually yellow and often showy. The leaves are various, and those of the stem alternate.

§ 1. *Aquatic herbs with the submersed leaves, if any, finely divided: petals white, the claw yellow: akenes transversely wrinkled.*

1. *R. aquatilis*, L., var. *trichophyllus*, Chaix. Stems long and coarsely filiform: leaves all submersed and cut into numerous soft capillary segments, which usually collapse when withdrawn from the water: akenes in a close globular head. — Common throughout the continent in stagnant or slow-flowing waters.

Var. *stagnatilis*, DC. Leaves all under water, the divisions and subdivisions short, spreading in one roundish plane, rigid, keeping their form without collapsing when withdrawn from the water. — The *R. divaricatus* of Gray's Manual and the Western reports. Rarer than the former, but with the same range.

§ 2. *Terrestrial herbs, but often growing in wet places, mostly erect: sepals green, rarely yellow: petals yellow: akenes neither wrinkled nor hispid.*

* *All the leaves undivided, the margins entire.*

2. *R. Flammula*, L., var. *reptans*, Gray. Glabrous throughout: stems filiform, creeping and rooting at the joints: leaves mostly lanceolate and acute at each end: petals half longer than the sepals: akenes few in a small globular head, plump; beak very short and curved. — Found in Colorado, but most common northward, where it extends across the continent.

3. *R. alismæfolius*, Geyer. Glabrous throughout: stems nearly or quite erect, 6 to 16 inches high, rather stout: leaves broadly lanceolate, blunt at apex: petals conspicuously nerved, nearly twice as long as the sepals: akenes slightly flattened, pointed with a nearly or quite straight beak, crowded in a compact ovate head. — The form called var. *montanus*, Watson, is the typical form. Rocky Mountains and westward. The Eastern species bearing this name is *R. ambigens*, Watson.

4. *R. Macauleyi*, Gray. Leaves lingulate, the truncate apex 3-toothed; radical ones (early ones oblong) tapering into a petiole; cauline ones sessile: sepals very dark villous outside: petals golden: carpels tapering into a short subulate style: fruit unknown, though head of akenes probably oblong. — Proc. Am. Acad. xv. 45. Mountains in San Juan Co., Colorado. The flowers resemble those of *R. nivalis*, but the remarkable foliage readily distinguishes it from every other species.

** *Radical leaves undivided: stem leaves, if any, toothed or lobed: glabrous perennials, 3 to 6 inches high.*

5. *R. Cymbalaria*, Pursh. Flowering stems or scapes leafless, 1 to 7-flowered: leaves broadly ovate or ovate-cordate, coarsely crenate, clustered at

the root and at the joints of the long filiform rooting runners: petals longer than the sepals: the akenes striate veined on the sides, enlarging upwards, with a short oblique beak: head oblong. — Across the continent in marshy ground.

6. **R. glaberrimus**, Hook. Stems 1 to 3-flowered: radical leaves broadly oval, either entire or with 3 large blunt teeth at the apex; stem-leaves cuneate at the base, 3-cleft to the middle: sepals half as long as the petals: akenes plump, tipped with a short curved beak: head globular. — From Colorado to Wyoming and Washington; also in California.

* * * Some or all the leaves cleft or divided.

+ Primary root-leaves crenate or toothed.

7. **R. rhomboideus**, Goldie. Dwarf (3 to 6 inches high), hairy: root-leaves roundish or rhombic-ovate, rarely subcordate; lowest stem-leaves similar or 3 to 5-lobed; the upper 3 to 5-parted, almost sessile, the lobes linear: petals large, exceeding the calyx: akenes orbicular with a minute beak. — S. W. Colorado to British America and eastward to Illinois and Michigan.

8. **R. abortivus**, L. Glabrous, 6 inches to 2 feet high: primary root-leaves round heart-shaped or kidney-form, barely crenate, the succeeding ones often 3-lobed or 3-parted; those of the stem and branches 3 to 5-parted or divided, their divisions oblong or narrowly wedge-form, mostly toothed: petals shorter than the reflexed sepals: akenes with a minute curved beak. — From the mountains eastward across the continent. Most variable as to foliage.

+ + Root-leaves lobed, cleft, or parted.

+ + Style straight or wanting.

9. **R. hyperboreus**, Rottb., var. **natans**, Regel. Stem filiform, creeping: leaves glabrous, petioled, 3-cleft; the lobes oval-oblong, divaricate, the lateral ones somewhat 2-cleft: heads of akenes globose, compact: style wanting. — In swamps at middle elevations, Colorado and northward.

10. **R. nivalis**, L. Stem about 1-flowered: radical leaves on long petioles, dilated, lobed, the lobes somewhat ovate; cauline ones nearly sessile, palmate: calyx very hirsute, shorter than the obovate entire petals: style as long as the glabrous ovaries. — In the mountains of British America.

Var. **Eschscholtzii**, Watson. Radical leaves 3-parted, the divisions lobed, ciliate: style shorter than the akenes. — Colorado, Yellowstone Park, and northward in the mountains.

11. **R. sceleratus**, L. Glabrous: stem thick and hollow, a foot high: root-leaves 3-lobed; lower stem-leaves 3-parted, the lobes obtusely cut and toothed; the uppermost almost sessile, with the lobes oblong-linear and nearly entire: petals scarcely exceeding the sepals: akenes barely mucronulate, very numerous, in oblong or cylindrical heads. — From Colorado northward, and across the continent. In drying, the numerous akenes are soon deciduous from the receptacle.

+ + + Style curved.

= Stem usually 1-flowered.

12. **R. pygmæus**, Wahl. Stem 1 to 2 inches high: leaves glabrous, 3 to 5-cleft; radical ones petioled: sepals glabrous, longer than the somewhat reflexed petals: heads oblong: akenes subglobose, pointed with a short hooked style. — Mountains of Colorado and far northward.

13. **R. adoneus**, Gray. Low, sparsely villous, becoming glabrous: stems branching from the base, 1 to 3-leaved above, sometimes sarmentose-decumbent and 2 to 3-flowered: leaves *twice pedately parted*, segments narrowly linear: petals golden-yellow, *twice exceeding the subvillous sepals*: akenes crowded in an oval head, turgid, with the rather long ensiform beak scarious-winged on each edge. — Proc. Acad. Philad. 1863, 56. High altitudes close to the snow, Colorado and northward.

= = *Stems bearing more than one flower.*

a. *Dwarf (2 to 3 inches high).*

14. **R. digitatus**, Hook. Very glabrous: leaves few, petioled, digitately lobed, the 3 to 5 segments narrowly lanceolate or oblong-spatulate, obtuse: flowers 2 or 3, terminal, with reflexed sepals and 7 to 11 oblong cuneate petals: akenes beaked with a subulate recurved style. — In the Wasatch, N. Utah, and northward into British America.

b. *A foot or two high.*

15. **R. affinis**, R. Br. Radical leaves petioled, *usually pedately multifid*: cauline ones subsessile, digitate, with broadly linear lobes: akenes with recurved beaks in oblong-cylindrical heads, more or less pubescent. — Colorado and northward.

Var. **leiocarpus**, Trautv. *Lower leaves usually lobed or crenate: flowers small: carpels smooth or somewhat pubescent.* — Colorado.

Var. **cardiophyllus**, Gray. *Hirsutely pubescent: radical leaves round-cordate, undivided or many-cleft; cauline ones palmately many-cleft: flowers an inch in diameter.* — Same range as the species.

16. **R. Nelsoni**, Gray. Sparingly pilose: *the simple radical leaves often 3 to 4 inches in diameter, more or less deeply 3-lobed; the uppermost rarely parted; the lower usually cordate in outline: petals not more than 3 lines long, exceeding the sepals: akenes pilose (sometimes glabrous), in a small head, rigid, more or less scattered, bearing a very much hooked style of the same length.* — Proc. Am. Acad. viii. 374. About Yellowstone Lake and far northward.

+ + + *Leaves alternately divided.*

17. **R. Pennsylvanicus**, L. Hirsute with rough spreading bristly hairs: stem stout, erect: divisions of the leaves stalked, somewhat ovate, unequally 3-cleft, sharply cut and toothed, acute: *petals pale, not exceeding the sepals: akenes not margined, pointed with a sharp straight beak, in oblong heads.* — Colorado and northward, and in the Atlantic States.

18. **R. repens**, L. Low, hairy or nearly glabrous: *stems ascending and some of them forming long runners: divisions of the leaves all (or at least the terminal one) stalked, broadly wedge-shaped or ovate, unequally 3-cleft or parted and variously cut: petals obovate, much larger than the spreading sepals: akenes strongly margined, pointed by a stout straightish beak, in globular heads.* — Across the continent.

19. **R. macranthus**, Scheele. Stem erect, taller, more or less hirsute with spreading hairs: leaves ternately or more frequently bi-ternately divided, segments usually stalked, laciniately lobed and toothed: *flowers large, with the sepals strictly reflexed: akenes crowded in subglobose heads, about equalling the*

broad subulate beaks. — *R. repens*, var. *macranthus*, Gray. In the Uinta Mountains, and from Oregon to Nevada and Texas. The largest of the genus sometimes reaching a height of 5 feet.

20. **R. Nuttallii**, Gray. *Smooth, 6 to 8 inches high: radical leaves bi-ternately divided, segments 3 to 5-parted, lobes oblong or linear, sometimes 2 to 3-cleft: petals spatulate, a little longer than the broader sepals which are also yellow: akenes rather few, in a globose head, cylindrical-oblong, grooved, many-nerved, tipped with a long, slender, incurved style.* — Colorado and Wyoming, along the eastern foothills.

21. **R. multifidus**, Pursh. *Stems floating or immersed, with the divisions of the leaves long and filiform; or rooting in the mud and the leaves round-reniform and more or less deeply lobed and toothed: petioles short, broadly stipulate-dilated at base: flowers large, the petals with conspicuous obovate scales: akenes in a small globose head, beaked by a short straight style.* — Colorado and northward, and across the continent.

+ + + + *Leaves pinnately divided.*

22. **R. orthorhyncus**, Hook. *More or less vilious, the stems often slender, 1 or 2 feet high: divisions of the leaves variously lobed and cut, the segments often narrow: sepals reflexed: petals bright yellow or purple-tinged outside: akenes large, flattened, in a close globose head, with a slender straight beak as long as the ovary.* — In the Bitter Root Mountains, northward and westward

6. CALTHA, L. MARSH MARIGOLD.

Sepals 5 to 12, deciduous. Pods each with several seeds, and when ripening spreading and flattened. — Glabrous perennial herbs, easily recognized by their undivided leaves and showy petal-like sepals.

1. **C. leptosepala**, DC. *Leaves round- to oblong-ovate (longer than broad), with a somewhat narrowed and quadrate base, usually very obscurely crenate above and rather coarsely and often acutely serrate below: flowers solitary, very rarely 2, the second flower subtended by a petioled leaf: sepals white or often tinged with blue.* — From New Mexico to Alaska. An excellent pot-herb.

7. TROLLIUS, L. GLOBE-FLOWER.

Sepals 5 to 15, petal-like. Pods sessile, many-seeded. — Smooth perennials, with large solitary terminal flowers and palmately parted and cut leaves.

1. **T. laxus**, Salisb. *Flowers pale greenish-yellow or nearly white: petals much shorter than the stamens.* — Associated with the preceding, but less common.

Var. **albiflorus**, Gray. *Stem 6 to 12 inches high, and flowers white.* — Near snow-banks. "The pure white and broader sepals, lower stature, and alpine station, distinguish this from the ordinary form," Colorado, Parry.

8. AQUILEGIA, L. COLUMBINE.

Sepals 5, regular, colored like the petals. Petals all alike, with a short spreading lip. Pods erect, many-seeded. — Perennials, with the leaflets of the 2 to 3 ternately compound leaves lobed. Recognized by its large showy flowers and prominent spurs.

* *Caulescent: spur longer or shorter than the calyx.*

+ *Spur straight.*

++ *Flowers red and yellow.*

1. **A. Canadensis**, L. *Spurs much longer than the sepals: flowers 2 inches long, scarlet, yellow inside (or rarely all over), nodding so that the spurs turn upwards: limb or lip of the petals distinct: stamens and styles longer than the ovate sepals.*—Along subalpine rivulets and eastward across the continent.

2. **A. formosa**, Fisch. *Like the preceding or stouter: spurs shorter, not longer than the elongated sepals.*—Colorado and northward, thence westward into Oregon.

++ ++ *Flowers never red.*

3. **A. cœrulea**, James. *Stem 1 to 3 feet high, glabrous: leaves mostly radical, glaucous beneath, the leaflets deeply cleft: flowers 2 to 2½ inches in diameter, pale blue, sometimes ochroleucous, pinkish, or white: spur very slender: sepals rhomboid-ovate, longer than the limb of the petals.*—On shaded slopes throughout the Rocky Mountains. A very beautiful and showy plant.

4. **A. chrysantha**, Gray. *Usually taller and more slender: peduncles often pubescent: flowers bright yellow throughout: spurs even more slender: sepals lanceolate-oblong, longer but not broader than the limb of the petals.*—Proc. Am. Acad. viii. 621. Colorado and southward.

+ + *Spur hooked at the tip.*

5. **A. flavescens**, Watson. *Plant 2 to 3 feet high, glabrous except the pubescent peduncles and carpels: flowers yellow, the sepals frequently tinged with scarlet: spurs shorter than the spreading or reflexed oval or oblong-ovate sepals: limb large and dilated: stamens long exerted.*—Bot. King's Rep. 10. Wyoming, Montana, and Idaho.

6. **A. brevistyla**, Hook. *Stems 6 to 8 inches high, spreading: leaves bi-ternate; leaflets 3-lobed, crenate: flowers small, blue, about 6 lines long, including the spur: sepals oblong-ovate: petals a little exceeding the stamens.*—*A. vulgaris*, var. *brevistyla*, Gray. Colorado and northward into British America.

* * *Acaulescent: spur shorter than the calyx: flowers blue.*

7. **A. Jonesii**, Parry. *Minutely soft-pubescent: scape 1 to 3 inches high, naked, 1-flowered: leaves all crowded and the persistent scale-like dilated bases of their petioles imbricated on the stout ascending branches of the rootstock; the partial petioles short or wanting, so that the 9 small obovate entire leaflets are in a dense cluster: pods reticulated, smooth.*—Am. Nat. viii. 211. Summit of Phlox Mountain, Wyoming, Parry.

9. DELPHINIUM, L. LARKSPUR.

Sepals 5, petal-like. Petals 2 or 4, irregular; when 4, the upper 2 developed backwards into a spur which is enclosed in the spur of the calyx. Pods many-seeded.—Erect herbs usually with palmately lobed, cleft, or dissected leaves, and racemose flowers, which are blue shading to white.

* *Not glandular pubescent.*

1. **D. azureum**, Michx. Stem slender, branching, often slightly pubescent: leaves deeply 3 to 5-parted, the divisions 2 to 3 times cleft, the lobes all narrowly linear: flowers sky-blue or whitish, in a strict not dense raceme: spur ascending, usually curved upwards. — Colorado, Wyoming, and eastward across the plains.

2. **D. Menziesii**, DC. Glabrous below, at least at the very base, pubescent above with spreading hairs, especially the inflorescence: leaves 5-parted, divisions 2 to 3-cleft: flowers large, deep-blue, in a loosely few- to many-flowered simple raceme: upper petals veined with purple: spur long and slender: ovaries somewhat tomentose. — Wyoming, Montana, and northwestward.

3. **D. bicolor**, Nutt. Very similar, but the whole plant glabrous throughout, including the ovaries, or occasionally somewhat tomentose-pubescent; and the flowers are uniformly smaller. — The *D. Menziesii* of Fl. Colorado and *D. Menziesii*, var. *Utahense*, of Bot. King's Rep. 12. Foothills of Colorado and northward. Closely resembles the eastern *D. tricornis*.

4. **D. scopulorum**, Gray. Pubescent with a fine hoary tomentum or glabrous: stem leafy: leaves orbicular in outline, 3 to 5-parted, the divisions deeply 2 to 3-cleft, the segments many-lobed or lacinate: flowers sparingly pilose without, in a many-flowered strict raceme: spur longer than the sepals: pods pubescent, on stout pedicels. — Pl. Wright. ii. 9. Rocky Mountains from New Mexico to British America.

* * *Glandular pubescent.*

5. **D. occidentale**, Watson. Known by the stiff glandular spreading pubescence, which extends rarely to the ovaries and fruit: flowers numerous, dull or dark blue, very variable in size, often in compound racemes: seeds light colored and somewhat spongy. — *D. elatum*, var. (?) *occidentale*, Watson. Alpine or subalpine, from Colorado to Oregon.

10. ACONITUM, L. ACONITE. MONKSHOOD. WOLFSBANE.

Sepals 5, petal-like. Petals 2 to 5; the upper 2 with long claws and irregular spur-like blades concealed within the hood; the lower 3 very minute or obsolete. Pods many-seeded. — Herbs with palmately lobed leaves.

1. **A. Columbianum**, Nutt. Stem stout, 3 to 6 feet high: more or less pubescent above with short spreading yellowish viscid hairs: divisions of the leaves broadly cuneate and laciniately toothed or lobed: flowers purple or white in a loose terminal raceme: the hood varying much in breadth and in length of beak. — Torr. & Gray, Fl. i. 34. *A. nasutum*, Hook. *A. Fischeri* of Bot. Calif. i. 12. Colorado, Wyoming, and westward to the Sierra Nevada.

11. ACTÆA, L. BANEERRY.

Sepals 4 to 6, petal-like. Petals 4 to 10. Stigma sessile, 2-lobed. Berry with many seeds, which are packed horizontally in 2 rows. — Perennial herbs with 2 to 3 ternately compound leaves.

1. **A. spicata**, L., var. *arguta*, Torr. Smooth, 1 to 2 feet high: leaflets larger and more serrated than in the next: petals oblong, obtuse: berries

either white or red, in a loose, rather *elongated raceme*. — From the mountains westward.

Var. **rubra**, Ait. *Raceme ovate: petals rhombic-spatulate*, much shorter than the stamens: berries cherry-red. — From the mountains eastward to the Atlantic.

ORDER 2. BERBERIDACEÆ. (BARBERRY FAMILY.)

Our species are shrubs with alternate simple or compound leaves and no stipules; the flower parts are distinct and free, and are opposite to each other instead of alternate; the anthers open by uplifted valves. — Sepals and petals imbricated and deciduous. Pistil one, simple; style short or none.

1. BERBERIS, L. BARBERRY.

Sepals 6, colored like the petals, with 3 or 6 closely appressed bractlets. Petals 6, yellow. Stamens 6. Stigma circular and peltate. Fruit a berry with 1 to 3 seeds. — Shrubs with yellow wood and the flowers in clustered bracteate racemes.

1. **B. repens**, Lindl. *A low shrub less than a foot high: leaflets 3 to 7, ovate, acute: racemes few, terminating the stems*. — Throughout the Rocky Mountains. This is the *B. Aquifolium* of Fl. Colorado and the various Western Reports. *B. Aquifolium* ranges farther west, especially in Oregon and Washington, and is a much larger shrub, with clusters of racemes.

2. **B. Fendleri**, Gray. *Much taller (3 to 6 feet), with branches smooth and shining as if varnished: leaves entire or irregularly spinulose-serrate: racemes pendulous, densely-flowered: calyx with conspicuous red bracts*. — Pl. Fendl. 5. S. W. Colorado, southward, and westward to S. California.

ORDER 3. NYMPHÆACEÆ. (WATER-LILY FAMILY.)

Aquatic herbs, with horizontal trunk-like rootstocks or sometimes tubers; the leaves (in ours) deeply cordate; flowers with all the parts distinct and free, solitary and axillary on long peduncles; stamens numerous.

1. NUPHAR, Smith. YELLOW POND-LILY. SPATTER-DOCK.

Sepals 5 to 12, persistent, usually yellow within and partly green without. Petals and stamens short and numerous, densely crowded around the ovary. Ovary 8 to 20-celled, crowned by a radiate stigma, the cells many-seeded. — In shallow water, sending up large leathery leaves which are usually upright, but sometimes floating.

1. **N. advena**, Ait. *Emersed and erect leaves thick, varying from roundish to ovate or almost oblong in outline, the sinus open, or closed, or narrow: sepals 6: petals like the stamens, thick and fleshy, truncate: fruit ovoid*. — Abundant in the Yellowstone Park, and extending northward and eastward across the continent.

2. **N. polysepalum**, Engelm. Larger: leaves 6 to 12 inches long, rounded above, deeply cordate at base: sepals 8 to 12: petals dilated and unlike the stamens, often tinged with red: fruit globular. — Mountain lakes in Colorado, westward and northward.

ORDER 4. **PAPAVERACEÆ.** (POPPY FAMILY.)

Herbs, usually with milky or orange-yellow juice; sepals 2 or 3, caducous; petals twice as many, in two sets; stamens indefinite; ovary 1-celled, with parietal placentæ; seeds numerous. — Leaves alternate, without stipules. Petals imbricated and commonly crumpled in the bud.

1. **Papaver.** Ovary incompletely several-celled by the projecting placentæ. Stigmas united into a radiate crown. Pod opening by chinks or pores under the edge of the stigma.
2. **Argemone.** Ovary strictly 1-celled. Pod opening by valves, and with the leaves prickly.

1. **P A P A V E R**, L. P O P P Y.

Sepals 2. Stigma 4 to 20-rayed. Pod short and turgid. — Herbs with a white juice, and nodding flower buds.

1. **P. nudicaule**, L. Scape 1-flowered, 2 to 3 inches high, naked, hispid as well as the calyx with brownish hairs: leaves lance-ovate in outline, deeply pinnatifid: petals lemon-yellow: pod obovate, hispid. — *P. alpinum* of the Fl. Colorado. Alpine. Colorado and in Arctic America.

2. **A R G E M O N E**, L. P R I C K L Y P O P P Y.

Sepals 2 or 3, often prickly. Stigma 3 to 6 rayed. Pod oblong; seeds crested. — Well marked by the prickly bristles and yellow juice. Leaves sessile, sinuate-lobed, with prickly teeth. Flower-buds erect.

1. **A. platyceras**, Link & Otto. Erect, 1 to 2½ feet high, hispid throughout or armed with rigid bristles or prickles: lower leaves attenuate to a winged petiole; the upper sessile or auriculate-clasping: flowers white: pod oblong. — *A. hispida*, Gray. Colorado to Mexico and westward.

It is doubtful whether *A. Mexicana* occurs in Colorado, but it ranges farther south.

ORDER 5. **FUMARIACEÆ.** (FUMITORY FAMILY.)

Tender herbs, with watery juice, dissected compound leaves, perfect regular hypogynous flowers with parts in twos, except the diadelphous stamens which are 6, ovary 1-celled, seeds, etc. as in *Papaveraceæ*, to which order Bentham & Hooker have united it.

1. **Dicentra.** Corolla heart-shaped (in ours) at the base.
2. **Corydalis.** Corolla 1-spurred at the base.

1. DICENTRA, Borkh.

Sepals 2, small and scale-like. Petals 4, in two sets; the outer pair larger, saccate at base, the tips spreading; the inner much narrower, spoon-shaped, the hollowed tips lightly united at the apex, thus forming a cavity which contains the anthers and stigma. Middle anther in each set 2-celled, lateral ones 1-celled. Stigma 2-lobed. Pod 1-celled. — Glabrous perennials with the fleshy root surmounted by a bulb-like cluster of fleshy grains and ternately or pinnately compound leaves.

1. *D. uniflora*, Kellogg. The 3 to 7 divisions of the leaves pinnatifid into a few linear-oblong or spatulate lobes: scape 2 to 3 bracted, 1-flowered: flowers flesh-colored, $\frac{1}{2}$ inch long, the divergent or reflexed tips of the outer petals equalling or exceeding the erect gibbous-saccate base; inner ones not crested, the blade broadly hastate: pod abruptly beaked with the short style. — Alpine. Wasatch and Teton Mountains, and westward in the Sierra Nevada.

2. CORYDALIS, DC.

Corolla one-spurred at the base on the upper side. Otherwise as in *Dicentra*.

* *Corolla golden-yellow; spur shorter than the rest of the flower.*

1. *C. aurea*, Willd. Stems low or decumbent: racemes simple: the slightly decurved spur *not half the length of the rest of the flower*: tips of the outer petals blunt, crestless and naked on the back: pods usually pendent: seeds smooth and even, turgid, marginless, partly covered by the scale-shaped aril. — From Colorado northward and eastward.

Var. *occidentalis*, Gray. *Spur longer: pods erect: seeds lenticular with acute margins.* — More common in our range than the type. Colorado to Montana, and eastward to Missouri and Texas.

Var. *micrantha*, Engelm. Flowers small, *nearly spurless, on short pedicels: pods ascending.* — From the Western Mississippi States to the Uinta Mountains.

2. *C. curvisiliqua*, Engelm. Differs from the last in having longer 4-angular pods ascending on very short pedicels: the acute-margined seeds *muricate.* — *C. aurea*, var. *curvisiliqua*, Gray. Common in the mountains of Colorado and southeastward.

* * *Corolla white or cream-color; spur longer than the rest of the flower*

3. *C. Brandegei*, Watson. Tall and stout (5 feet high): leaves twice or thrice pinnately divided; the lanceolate leaflets $\frac{1}{2}$ to 1 inch long, acute or acuminate: hood not crested, the margins folded back and *not projecting beyond the obtuse summit*: pod oblong-obovate, obtuse, reflexed. — Mountains of S. Colorado and in the Wasatch. Formerly referred to *C. Caseana*, which has a more westerly range.

4. *C. Cusickii*, Watson. Leaves bipinnately divided; the oblong-oval leaflets acute at each end, half-inch long: the broad margins of the hood produced beyond its acute apex and folded back over the narrow and somewhat crisped or erose crest: pod acute. — Extending from Oregon into the Bitter Root Mountains.

ORDER 6. CRUCIFERÆ. (MUSTARD FAMILY.)

Herbs, with a pungent watery juice, cruciform corolla, tetradynamous stamens, and a 2-celled pod with 2 parietal placentæ. — Sepals 4, deciduous. Petals 4. Ovary 2-celled by a partition which stretches across from the placentæ, rarely 1-celled. Style undivided or none; stigma entire or 2-lobed. Fruit a silique or silicle, the two valves falling away from the partition, which persists and is called the *replum*, in a few genera indehiscent. Ovules few or numerous. Flowers generally in racemes and without bractlets. Leaves alternate, without stipules. The mature pods are necessary for analysis.

I. Pod dehiscent, 2-valved.

* Pod strongly compressed parallel with the broad partition: cotyledons accumbent (i. e. the radicle and cotyledons appearing in cross-section thus o8).

+ Pod short; valves nerveless or faintly 1-nerved: flowers white or yellow.

1. **Draba**. Pod ovate to oblong or linear, few to many-seeded; valves flat or convex. Seeds wingless. Low, flowers racemose.

+ + Pod elongated.

+ + Valves nerveless; replum thickened; seeds wingless: flowers white: leaves all petioled.

2. **Cardamine**. Pod moderately beaked or pointed. Stems leafy, with elongated racemes.

+ + Valves 1-nerved; replum thin; seeds flat, often winged or margined: flowers white to purple (sometimes yellowish in *Streptanthus*): cauline leaves (if any) sessile.

3. **Parrya**. Anthers linear. Petals broadly obovate. Seeds in one or two rows. Scape naked.

4. **Arabis**. Anthers short, scarcely emarginate at base. Petals with a flat blade and claw. Calyx short or narrow, rarely colored. Seeds in 1 or 2 rows.

5. **Streptanthus**. Anthers elongated, sagittate at base. Petals often without a dilated blade, more or less twisted or undulate, the claw channelled. Calyx dilated and usually colored. Seeds in one row.

* * Pod terete or 4-angled, slightly or not at all compressed; seeds not margined.

+ Pod long-linear (1 to 4 inches); valves 1-nerved; seeds in 1 row, oblong, somewhat flattened, cotyledons incumbent (i. e. the radicle and cotyledons appearing in cross-section thus oD). Stout biennials or perennials.

+ + Flowers greenish-yellow to purple: anthers sagittate.

6. **Caulanthus**. Petals with a broad claw, somewhat dilated above and undulate, little longer than the broad sepals, greenish-yellow or purple. Filaments included. Stigma nearly sessile, somewhat 2-lobed. Pod sessile, 3 inches long or more.

7. **Thelypodium**. Petals with narrow claw and flat linear to rounded limb, much exceeding the narrow sepals, usually pink to purple. Filaments often exerted. Style short; stigma mostly entire. Pod sessile or short-stipitate.

+ + Flowers yellow.

8. **Stanleya**. Pod somewhat terete, long-stipitate. Stigma sessile, entire. Anthers not sagittate, spirally coiled. Leaves entire or pinnatifid.

9. **Erysimum**. Pod 4-angled, sessile. Stigma 2-lobed. Anthers sagittate, not coiled. Leaves narrow, entire or repandly toothed.

+ + Pod linear, mostly less than 1 inch long; valves 1 to 3-nerved; seeds in 1 or 2 rows, globose to oblong: flowers usually yellow (white or pinkish in *Smelowskia*): at least the lower leaves pinnatifid.¹

¹ *Brassica*, an introduced genus, may be looked for in this group, differing from the other genera in its nearly terete pod with a long stout beak, globose seeds with the cotyledons infolding the radicle, and long sagittate anthers. See foot-note, p. 23

10. **Barbarea.** Pod somewhat 4-angled, pointed. Seeds oblong; cotyledons nearly accumbent. Anthers short, oblong. Leaves lyrate-pinnatifid. A smooth marsh perennial.
11. **Sisymbrium.** Pod nearly terete, short-pointed or obtuse. Seeds oblong; cotyledons incumbent. Anthers linear-oblong, sagittate. Mostly annual, with finely dissected or entire leaves.
12. **Smelowskia.** Pod short, 4-angled, pointed at each end. Alpine perennials with narrowly pinnatifid leaves; otherwise as *Sisymbrium*.
 + + + Pod oblong-cylindric to globose; valves strongly convex, nerveless; seeds in 2 rows, cotyledons accumbent.¹
13. **Nasturtium.** Pod oblong or short-linear. Flowers white or yellow. Smooth or somewhat hispid.
14. **Vesicaria.** Pod ovate to globose. Seed flattened. Flowers yellow. Densely stellate-canescens.
- * * * Pod more or less flattened contrary to the partition, which is narrower than the valves; seeds not winged.
- + Valves 1-nerved or obtusely carinate, not winged; cells several-seeded; cotyledons incumbent; flowers white.
15. **Subularia.** Pod ovoid, slightly compressed. A dwarf stemless aquatic, smooth, with tufted subulate leaves.
16. **Capsella.** Pod obcordate or oblong, much compressed. Nearly smooth annuals.
- + + Valves acutely carinate or winged; cells few (1 to 5)-seeded; cotyledons accumbent (mostly incumbent in *Lepidium*): flowers white.
17. **Thlaspi.** Pod cuneate-oblong; valves sharply carinate; cells 2 to 4-seeded. A smooth alpine perennial with entire leaves.
18. **Lepidium.** Pod orbicular or obovate, 2-winged at the summit; cells 1 to 2-seeded.
- + + + Valves inflated, nerveless; cells several-seeded; cotyledons accumbent: flowers yellow.
19. **Physaria.** Pod didymous; cells nearly globular. Stellate-canescens perennials with entire leaves.
- II. Pod of 2 indehiscent cells, separating at maturity from the persistent axis.²
20. **Biscutella.** Cells flat, nearly orbicular, 1-seeded. Flowers rather large. Stigma dilated or conical, nearly sessile.

1. DRABA, L. WHITLOW-GRASS.

Sepals equal. Filaments mostly flattened, without teeth: anthers rounded or oval. — Leaves entire or toothed.

* *Stems scape-like, leafless (or perhaps 1 or 2-leaved).*

1. **D. stellata**, Jacq. Scape with a single leaf, pubescent: leaves oblong-oval, tomentose with a short stellate pubescence: flowers white: pedicels puberulent: pods oblong. — Uinta and Teton Mountains, and far northward.

Var. **nivalis**, Regel. Scape naked or sometimes with one or two leaves, pubescent: leaves oblanceolate to obovate, canescent with a stellate pubescence: pods narrowly oblong, and, with the pedicels, becoming glabrous. — *D. nemorosa*, var *alpina*, of the Fl. Colorado. High peaks about Mt. Lincoln, Colorado, and in Arctic America.

Var. **Johannis**, Regel. Scape naked or with a single leaf, glabrous: leaves ovate, with a short woolly pubescence: pods long, linear, and with the pedi-

¹ *Camelina*, an introduced genus, is distinguished by its pear-shaped pod, 1-nerved valves, incumbent cotyledons, and small yellow flowers. See foot-note, p. 25.

² *Raphanus*, an introduced genus, is known by its elongated 1-celled or transversely jointed pod, which is attenuated above. See foot-note, p. 27.

cels glabrous. — *D. muricella*, Wahl. ? of Bot. King's Exp. 21; *D. nivalis* of Hayd. Rep. 1870. Uinta Mountains and far northward.

2. **D. crassifolia**, Grah. Scape naked or with a single leaf, 1 to 3 inches high: *leaves lanceolate-linear*, entire or somewhat serrate, *ciliate with simple hairs*: flowers small, *yellow or white*: *petals a little exceeding the sepals*, retuse: pods ovate-elliptical, glabrous. — Alpine, from Colorado northward, and in California.

3. **D. alpina**, L. Rather rigid: *scape naked*, mostly somewhat hirsute: *leaves spatulate-lanceolate*, more or less pilose with branching hairs: *petals yellow*, more than twice the length of the sepals: pods somewhat corymbed, oblong-elliptical. — Alpine, Colorado, Uintas, and northward to Arctic America.

Var. **glacialis**, Dickie. Dwarf: leaves more rigid, *linear or narrowly oblanceolate*, more or less strongly carinate, *stellate pubescent*, not ciliate: pods short-ovate, pubescent. — *D. glacialis* of Hayd. Rep. 1871, 1872. Peaks about Yellowstone Lake and far northward.

* * *Stems leafy.*

+ *Flowers white.*

4. **D. incana**, L. Hoary pubescent, seldom branching at the base: *leaves oblong-lanceolate*, linear, or the lower spatulate: pods oblong-lanceolate, often pubescent, on short erect pedicels.

Var. **confusa**, Poir. Leaves sparingly toothed: pods pubescent. — Mountains of Colorado and in British America.

5. **D. cuneifolia**, Nutt. Hirsute-pubescent throughout with branching hairs, usually branching at base, leafy below or only at base: *leaves obovate or spatulate with a narrow or cuneate base*, sparingly toothed toward the apex: pods linear-oblong, somewhat pubescent with short ascending hairs, on spreading pedicels. — Southern Colorado, eastward, and probably westward.

+ + *Flowers yellow (white in one variety of No. 7).*

++ *Pods glabrous (except in one variety of No. 7).*

6. **D. stenoloba**, Ledeb. Somewhat villous with spreading hairs, glabrous above: stems erect, with divergent or decumbent branches near the base: *leaves oblanceolate*, rather thin, rarely and sparingly toothed; the cauline few and sessile: petals bright or pale yellow: pods linear, in an elongated raceme on spreading scattered pedicels; style none. — *D. nemorosa*, var. *lutea*, of Bot. King's Exp. 22. Colorado mountains, the Uintas and Wasatch, and westward to California.

7. **D. nemorosa**, L. Leaves oblong or somewhat lanceolate, more or less toothed: racemes elongated: petals emarginate, small: pods elliptical-oblong, half the length of the horizontal or widely spreading pedicels.

Var. **leiocarpa**, Lindb. Often with stem nearly or quite leafless, and petals sometimes pinkish-white: sepals sparsely hirsute: *pedicels scarcely exceeding or even shorter than the glabrous pods*. — *D. nemorosa*, var. *lutea*, of Fl. Colorado and Hayd. Rep. 1871. Colorado and throughout Yellowstone Park.

Var. **hebecarpa**, Lindb. Pubescent: stem branched: pods pubescent, one third the length of the pedicels. — *D. nemorosa* of Bot. King's Exp. 22 and Hayd. Rep. 1871. In the mountains from Colorado to Arctic America.

8. **D. chrysantha**, Watson. Stems decumbent or erect from a branching rootstock, *which becomes covered with the persistent bases of dead leaves*, sparingly pubescent with simple hairs: basal leaves narrowly oblanceolate, mostly entire; the cauline oblanceolate to lanceolate: *flowers bright yellow*: pod oblong, acute at each end and *beaked by a slender style*. — Proc. Am. Acad. xvii. 364. In the high mountains of Colorado and southward into Arizona.

++ ++ *Pods not glabrous.*

9. **D. montana**, Watson. *Hoary-villous with simple or branching rigid hairs, rather stout*, erect, simple or sparingly branched, becoming a span high or less: *leaves rosulate and rather crowded at and above the base of the stem*, oblanceolate, sparingly toothed: pods *linear-oblong, obtusish, roughly puberulent*, nearly erect upon spreading pedicels; *style none*. — Wheeler's Rep. vi. 63. Colorado.

10. **D. aurea**, Vahl. *More or less canescently stellate pubescent* and usually somewhat villous with branching hairs: stems 3 to 18 inches high, solitary or several from the same root, simple or branched: leaves oblanceolate, petioled; the upper sessile, oblong to oblong-ovate, entire or sometimes sparingly toothed: *petals yellow fading to white*: pods *linear-lanceolate, attenuate upward into a short style, puberulent, often somewhat twisted*. — From Colorado to British America.

Var. **stylosa**, Gray. Style as long as in the next. — Southwestern Colorado.

11. **D. streptocarpa**, Gray. A span high, *with simple or simply forked, long, rigid, shaggy, spreading hairs*: radical leaves rosulate, spatulate-lanceolate, *attenuated into a large-margined petiole*; cauline very entire, sessile: racemes often paniculate: *petals golden-yellow*: pods *linear or oblong-ovate, minutely or strongly hispid-ciliate, usually much twisted* with often 3 or 4 turns; *style long*. — In the mountains of Colorado to the very summit, the alpine forms being much dwarfed.

12. **D. ventosa**, Gray. *Depressed and cespitose, canescently tomentose* throughout, the pubescence stellate: *leaves crowded on the mostly tufted branches*, spatulate-oblong or obovate, entire: peduncle in fruit exserted beyond the leaves: *petals golden-yellow*: pod *oval or orbicular, tomentulose-hirsute, tipped with a short distinct style*. — Am. Naturalist, viii. 212. "On a high rocky peak overlooking Snake and Wind River valleys." Parry.

2. CARDAMINE, L. BITTER CRESS.

Sepals equal. Pod linear, seeds in one row. — Growing in wet places, usually with running rootstocks or small tubers; leaves all petioled, simple or pinnate.

1. **C. cordifolia**, Gray. Stem 1 to 3 feet high, erect, simple, *leafy to the top*: leaves *cordate, sparingly repand-dentate or angular-toothed*, ciliate, 2 to 4 inches across; lowest orbicular; upper triangular-cordate: *flowers rather large*: pods *erect*. — *C. rhomboidea* of Hayd. Rep. 1871. From New Mexico and Colorado to Oregon.

2. **C. Breweri**, Watson. Stem 6 to 18 inches high, *flexuous, decumbent at base*, usually simple: leaflets 1 or 2 pairs, rounded or oblong, *the terminal much*

the largest, entire or coarsely sinuate-toothed or lobed, often cordate at base; radical leaves mostly simple and cordate-reniform: pods obtuse or scarcely beaked with a short style, *ascending*. — Proc. Am. Acad. x. 339. *C. pauciseeta* of Hayd. Rep. 1870, 1871, 1872. From Wyoming to California and Oregon.

3. *C. hirsuta*, L. Stem 3 to 12 inches high, erect or ascending from a spreading cluster of root-leaves: leaflets 3 to 7 pairs, rounded; those of the upper leaves oblong or linear and often confluent: flowers small: pods erect or ascending in line with the pedicels; style very short or almost none. — From Colorado to Alaska and eastward across the continent.

3. PARRYA, R. Br.

Style rather short; lobes of the stigma connate. Seeds flat, orbicular, with a broad membranous border. — Low herbs, with thick perennial roots and numerous scapes with racemed flowers.

1. *P. nudicaulis*, Regel. Rootstock fusiform: scape 4 to 6 inches high: leaves broadly lanceolate, incisely toothed: petals rose-color or purple, retuse: pods broadly linear, erect, slightly incurved, somewhat constricted between the seeds, which are slightly corrugated.

Var. *aspera*, Regel. Pilose with glandular hairs.

Var. *glabra*, Regel. Whole plant glabrous. — Both varieties are included in the *P. macrocarpa* of Bot. King's Exp. 14 and Torr. & Gray, Fl. i. 88. Near the summit of one of the highest peaks of the Uintas (*Watson*).

4. ARABIS, L. ROCK CRESS.

Anthers short, hardly emarginate at base. Stigma entire or somewhat 2-lobed. Pod linear. Seeds flat and usually winged. — Erect, with perpendicular roots and undivided leaves, the cauline usually clasping and auricled at base.

* *Biennials: pods erect or ascending: flowers small, white or nearly so.*

1. *A. perfoliata*, Lam. Glaucous: stem stout, usually simple, 2 to 4 feet high, mostly glabrous but often hirsute toward the base: lower leaves spatulate, sinuate-pinnatifid or toothed; the cauline entire, ovate or ovate-lanceolate, clasping by the sagittate base: petals little exceeding the sepals: pods erect and usually appressed, narrowly linear; style short: seeds in two rows, narrowly winged or wingless. — Across the continent and far northward.

2. *A. hirsuta*, Scop. Rough-hairy, sometimes smoothish, 1 to 2 feet high: leaves often rosulate at the base; the cauline ovate to oblong or lanceolate, entire or toothed, partly clasping by a somewhat sagittate or cordate base: petals greenish-white, longer than the sepals: pedicels and pods strictly upright; style scarcely any: seeds in one row, wingless. — Colorado and northward, and eastward across the continent.

3. *A. spathulata*, Nutt. Hirsute, dwarf and somewhat caespitose, about 4 inches high: root thick, crowned with vestiges of former leaves and stems: leaves spatulate-oblong, entire; radical leaves on rather long petioles: petals about twice the length of the sepals: pedicel about half the length of the pod, which is rather short, diverging, pointed with a distinct slender style: seeds with

a narrow margin. — Along the Platte and westward to W. Nevada and Oregon.

4. **A. lyrata**, L. Low, diffuse or spreading from the base, mostly glabrous, except the lyrate-pinnatifid root-leaves; cauline leaves scattered, spatulate or linear with a tapering base: petals much longer than the yellowish sepals: pods ascending or spreading: seeds marginless. — From Colorado northward and eastward.

* * Mostly perennials: pods usually erect or ascending flowers mostly larger and deeper-colored.

5. **A. Drummondii**, Gray. Scarcely glaucous, 1 to 2 feet high: stem-leaves lanceolate or oblong-linear and sagittate, or the lowest spatulate: petals white or rose-color, fully twice the length of the sepals: pedicels and pods loosely erect or ascending or spreading: seeds wing-margined. — Throughout the whole Rocky Mountain region and eastward across the continent. Very variable.

6. **A. Lyalli**, Watson. Bright green or glaucous and glabrous, sometimes villous below, rarely more or less canescent with stellate pubescence: stems slender from a branching base, 2 to 15 inches high: radical leaves oblanceolate, entire; cauline oblong-lanceolate, clasping by a sagittate base: petals light pink, twice longer than the sepals: style none: seeds in 2 rows, narrowly winged. — Proc. Am. Acad. xi. 122. *A. Drummondii*, var. *alpina*, of Fl. Colorado and Hayd. Rep. 1871, 1872. Alpine and subalpine. Colorado, Utah, Wyoming, and westward.

7. **A. canescens**, Nutt. Densely and finely stellate-pubescent, 2 to 6 inches high, tufted: leaves narrowly linear-oblanceolate to broadly spatulate, entire; cauline oblong and clasping: petals pale-purple: pods glabrous, tipped by a thick nearly sessile stigma, more or less spreading or reflexed on short pedicels: seeds in 1 row, broadly winged. — Wyoming to Nevada and California.

* * * Perennial: pods reflexed or recurved: style none.

8. **A. Holbœllii**, Hornem. More or less stellate-pubescent, rarely hirsute or even glabrous: stem $\frac{1}{2}$ to 2 feet high, simple or branching: lower leaves spatulate, entire or denticulate: petals twice longer than the sepals, white or rose-color or rarely purple, becoming reflexed. — *A. retrofracta*, Grah. From the Sierra Nevada to New Mexico and Arctic America, and eastward to the Saskatchewan.

5. STREPTANTHUS, Nutt.

Anthers elongated, sagittate; longer filaments sometimes connate. Stigma simple. Pod linear. Seeds flat, broadly winged. — Ours is a perennial, with stem-leaves clasping by a broad auriculate base.

1. **S. cordatus**, Nutt. Glabrous or glaucous: stem simple, 1 to 2 feet high, rather stout: leaves thick, usually repandly toothed toward the apex, the teeth often setosely tipped; lower leaves spatulate-ovate or obovate, cauline cordate to oblong or ovate-lanceolate: petals about half longer than the sepals, greenish-yellow to purple: pods nearly straight, loosely spreading. — Mountains of Arizona, Colorado, and Wyoming, and west to the Sierra Nevada.

6. CAULANTHUS, Watson.

Sepals large, nearly equally saccate at base. Anthers linear, curved. — Ours are stout perennials, with lyrate and entire leaves and greenish-yellow flowers.

1. **C. hastatus**, Watson. Glabrous, simple or somewhat branched: leaves petioled, very variable; radical ones lyrate or entire, the terminal leaflet ovate, hastate, or truncate at base, the lateral leaflets very small; cauline ovate-oblong, entire, hastate, rounded or cuneate at base: flowers in a loose virgate raceme, reflexed: sepals narrow, distant: petals (sometimes nearly wanting) equalling the sepals, toothed on the sides: pods spreading. — Bot. King's Exp. 28, with plate. On shaded slopes in the Wasatch and Uinta Mountains.

7. THELYPODIUM, Endl.

Sepals narrow, equal at base. Anthers linear, curved. — Mostly stout and coarse biennials.

* *Leaves entire.*

1. **T. integrifolium**, Endl. Stem 3 to 5 feet high, attenuated upward and sending out numerous branches toward the summit: radical leaves petioled, oblong-elliptical; cauline lanceolate, sessile, uppermost nearly linear: flowers crowded, pale rose-color: pedicels almost horizontal: pod short, abruptly pointed, on a short stipe. — From New Mexico to the Upper Missouri and Oregon; also in California.

2. **T. linearifolium**, Watson. Stem 1 foot or more high, often branched from the base, erect, paniculate at the top: leaves linear, or the lower lanceolate, sessile: sepals turning purplish: petals rose-purple: pods erect, on spreading pedicels, very slender, teretish, apiculate with a very short style. — Bot. King's Exp. 25. *Streptanthus linearifolius*, Gray. Wyoming, Colorado, and southward.

3. **T. sagittatum**, Endl. Stems weak, rarely erect, 12 to 18 inches high: radical leaves long-petioled, lanceolate; cauline sagittate and clasping: sepals purplish: petals pale pink: pods somewhat torulose, acuminate with the rather long style, spreading. — W. Wyoming, S. W. Montana, to Utah and Nevada.

4. **T. Nuttallii**, Watson. Resembling the last but stouter and more erect, 3 to 5 feet high: radical leaves ovate: sepals and petals bright purple, rarely whitish. — Bot. King's Exp. 26. *Streptanthus sagittatus*, Nutt. Wyoming and Montana to Oregon and California.

* * *At least the radical leaves toothed.*

5. **T. Wrightii**, Gray. Stem 2 to 3 feet high: leaves lanceolate, repand-dentate or denticulate, all narrowed into a short petiole: flowering racemes short and dense; pedicels divaricate: petals scarcely exceeding the sepals: pods widely spreading, on a very short stipe. — Colorado and southward.

8. STANLEYA, Nutt.

Sepals narrow, spreading, yellow. Petals with long connivent claws. Filaments much elongated. — Stout perennials with large flowers in elongated racemes.

1. *S. pinnatifida*, Nutt. Stems 2 to 3 feet high, *decumbent at base*: lower leaves *lyrate-pinnatifid*; upper leaves entire, *lanceolate, narrowed at base to a slender petiole*: pods somewhat torulose, twice longer than the stipe. — *S. integrifolia*, James. From Arizona and New Mexico to the head-waters of the Missouri, eastward to Western Iowa, and westward to California.

2. *S. tomentosa*, Parry. Stems 1 to 3 feet high, *very stout, white-villous or hirsute throughout*: radical and lower leaves as in the last; upper ones entire and *hastate*, passing into lanceolate and finally subulate bracts: raceme very dense and thick, cylindrical, becoming 1 to 1½ feet long, with pale cream-colored flowers. — Am. Naturalist, viii. 212. "Owl Creek, Wyoming, on dry slopes," Parry.

3. *S. viridiflora*, Nutt. Stems 2 to 4 feet high, simple, *erect, glabrous*: radical leaves *obovate or lanceolate, entire or with a few runcinate teeth towards the base*; cauline *lanceolate, clasping*: sepals and petals greenish-yellow: pods torulose. — N. Nevada, Utah, Wyoming, and northward.

9. ERYSIMUM, L.

Sepals erect, the alternate ones strongly gibbous at base. Petals long-clawed, with a flat blade. — Leaves not clasping; the flowers often large, yellow or orange, or occasionally purple.

* *Flowers small: pods small and short.*

1. *E. cheiranthoides*, L. Minutely roughish, slender, branching: leaves lanceolate, scarcely toothed: pods very obtusely angled, ascending on slender divergent pedicels. — From Colorado to Arctic America and westward.

* * *Flowers showy: pods elongated.*

2. *E. asperum*, DC. *Canescent with short appressed hairs*: stems solitary and simple, rarely branched above: leaves *oblanccolate or narrowly spatulate*: the cauline linear to linear-lanceolate, *entire or sparingly repand*: petals *light yellow to deep orange or purple*: pods ascending on stout spreading pedicels. — From Mexico to British America, and from California to Texas and Ohio.

Var. *Arkansanum*, Gray. *Minutely roughish-hoary*: leaves lanceolate, somewhat toothed: pods *nearly erect on very short pedicels, exactly 4-sided*. — On the plains and in the mountains of Colorado and eastward.

3. *E. pumilum*, Nutt. *Somewhat scabrous*: stems 2 to 4 inches high: leaves linear, all entire: flowers pale yellow: pods flatly 4-sided, very long, erect, on very short pedicels. — *E. asperum*, var. *pumilum*, and *Hesperis Pullasii* of Fl. Colorado. Alpine in Colorado, also in the foothills of Nevada.

4. *E. parviflorum*, Nutt. *Canescent and scabrous*: stem low and simple: leaves all linear or somewhat lanceolate, almost wholly entire, densely clustered at the base of the stem: flowers small, sulphur-yellow: pods erect. — *E. asperum*, var. *inconspicuum*, of Bot. King's Exp. 24 and Bot. Calif. i. 39. Nevada to the Saskatchewan.

10. BARBAREA, R. Br. WINTER CRESS.

Valves somewhat carinate. Seeds in one row, turgid, marginless. — Erect and branching, with angled stems.

1. *B. vulgaris*, R. Br. Stem 1 to 3 feet high: lower leaves lyrate-pinnatifid, with a larger rounded terminal lobe and 1 to 5 pairs of lateral ones; upper leaves obovate, more or less pinnatifid at base: pods erect, often appressed. — From Oregon eastward.

11. SISYMBRIUM,¹ L. HEDGE MUSTARD.

Sepals scarcely gibbous at base. Seeds not margined. — Erect herbs, with small flowers, the leaves not clasping or auriculate, rarely entire.

* *Leaves pinnate or bipinnate.*

1. *S. canescens*, Nutt. *Canescent with short branching hairs: stems* $\frac{1}{2}$ to $2\frac{1}{2}$ feet high: leaves 1 to 2-pinnate, with the segments more or less deeply pinnatifid or toothed: pods acute at each end and pointed with the very short style, *shorter than the slender spreading pedicels: seeds in two rows.* — Very common on the plains and in the mountains. From Colorado to Arctic America, westward to California, and eastward to New York and Pennsylvania.

2. *S. incisum*, Engelm. *Pubescence short, more or less glandular: stems* 1 to 4 feet high: leaves pinnate, with the segments linear to ovate-oblong, more or less deeply pinnatifid, sometimes entire: pods pointed at both ends, *mostly exceeding the spreading pedicels: seeds in one row.* — *S. Californicum*, Watson in Bot. King's Exp. 23. Oregon and Washington, eastward to Winnipeg Valley and southward to New Mexico.

* * *Leaves entire or toothed.*

3. *S. glaucum*, Nutt. *Glaucous, about 1 foot high: radical leaves small, spatulate; cauline ovate, sagittate and clasping, rather acute: flowers very small, pale purple: pods erect: seeds in one or two rows.* — South Park, Colorado, and northwestward to Oregon.

4. *S. virgatum*, Nutt. *Canescently hirsute with simple and stellate hairs: stem about a span high, virgately branched from the base: leaves lanceolate-linear, clasping; lower ones denticulate or entire: flowers larger, pale purple: pods erect: seeds in two rows.* — On the Platte and its tributaries.

5. *S. linifolium*, Nutt. *Glabrous and glaucous, 1 to $1\frac{1}{2}$ feet high: leaves narrowly oblanceolate or linear: flowers light yellow: pods ascending on short spreading pedicels, with short thick styles: seeds in one row.* — *S. junceum* of Hayd. Rep. 1871, 1872. W. Wyoming and northwestward through Montana and Idaho.

¹ BRASSICA is an allied genus, represented in our range by the following introduced species: —

B. Sinapisstrum, Boiss. Known by its rough spreading hairs, lower leaves usually with a large coarsely toothed terminal lobe, upper leaves often undivided, and the pods more than a third occupied by the stout 2-edged beak. — Around settlements in S. Montana and Idaho, and undoubtedly elsewhere.

12. **SMELOWSKIA**, C. A. Meyer.

Dwarf alpine perennials, distinguished from *Sisymbrium* by the short 4-angled pods.

1. **S. calycina**, C. A. Meyer. Densely white-tomentose to nearly glabrous, cespitose, the much-branched rootstock thickly covered with the sheathing bases of dead leaves: leaves mostly radical and with long slender petioles, pinnate or pinnatifid; segments linear to oblong: pod beaked with a short style and broad stigma, ascending on spreading pedicels: seeds in one row. — From Colorado to California and Oregon, and northward.

13. **NASTURTIUM**, R. Br. WATER-CRESS.

Growing in water or in moist places, smooth or nearly so, with the leaves pinnatifid or lyrate.

* *Flowers small, yellow or yellowish.*

1. **N. obtusum**, Nutt. Glabrous or nearly so: stems much branched: leaves pinnately parted or divided, often lyrate, decurrent; segments oblong-roundish, obtusely toothed or repand: racemes elongated in fruit: pods ovate to linear-oblong, twice the length of the pedicels; style short. — From Colorado to the headwaters of the Yellowstone and eastward. Growing in the spray of the Lower Falls of the Yellowstone.

Var. (?) **alpinum**, Watson. Dwarf: leaves oblong, entire or with a few teeth or coarsely lyrate-pinnatifid: pods mostly shorter than the pedicels. — Bot. King's Exp. 15. Uinta Mountains.

2. **N. palustre**, DC. Stout, glabrous, erect, 1 to 3 feet high: leaves lanceolate, lyrate-pinnatifid, petioled: pods oblong, equalling the spreading pedicels, tipped by the prominent style. — E. California to Colorado, thence northward and eastward.

Var. **hispidum**, Fisch. & Meyer. Somewhat hispid: pods shorter, globose-oblong. — The more common form.

3. **N. curvisiliqua**, Nutt. Smooth, usually erect, $\frac{1}{2}$ to 1 foot high: leaves narrowly oblong or oblanceolate, pinnatifid with oblong usually toothed lobes, rarely only sinuate-toothed: pods rather slender on pedicels of about the same length, both often strongly curved; style prominent or none. — W. Wyoming and Idaho to Washington and California.

4. **N. sinuatum**, Nutt. Stems diffuse, slender, decumbent, smooth or slightly roughened, from perennial creeping or subterranean shoots: leaves lanceolate, usually narrow, regularly sinuate-pinnatifid with numerous linear-oblong nearly entire lobes: pods linear, tipped with the long style, becoming curved, as also the slender pedicel. — From New Mexico to the Upper Mississippi and westward to the Sierra Nevada.

* * *Flowers white.*¹

5. **N. trachycarpum**, Gray. Nearly glabrous, erect, branching: leaves lyrate-subpinnatifid: pods oblong-linear, papillose-roughened, curved-

¹ *N. officinale*, R. Br., is a smooth procumbent aquatic rooting at the joints, with pinnate leaves and sinuate leaflets, and with spreading pedicels and a short thick style. — Introduced in the streams about Denver and Salt Lake City, and doubtless elsewhere.

ascending on stout pedicels, soon recurved, shorter than the long subulate style. — Proc. Am. Acad. xii. 54. S. W. Colorado on the San Juan, etc., *Brandegee*.

14. VESICARIA,¹ Tourn. BLADDER-POD.

Low densely stellate-canescient herbs, with large yellow flowers, entire or sinuately toothed leaves, and long slender styles.

* *Pod smooth.*

1. *V. Fendleri*, Gray. Low, spreading from a thick woody caudex: leaves linear or linear-spatulate, crowded, mostly entire: raceme densely many-flowered: pod membranaceous. — Pl. Fendl. 9. *V. stenophylla*, Gray, of Fl. Colorado, 6. Southern Colorado and southward.

* * *Pod hairy.*

2. *V. Ludoviciana*, DC. Stem simple or somewhat branched above: radical leaves spatulate, entire; cauline linear: pod obovate, globose, a little longer than the style. — Colorado and Wyoming.

3. *V. montana*, Gray. Stems spreading, leafy: radical leaves subovate, petioled, sometimes 1 or 2-toothed; cauline spatulate: fruiting raceme elongated: pod oval or ellipsoidal, a little longer than the style and a little shorter than the upwardly curving spreading pedicel. — Mountains of Colorado and Wyoming, also in California and Oregon.

4. *V. alpina*, Nutt. Dwarf and caespitose: leaves linear-spatulate, entire: flowers in short corymbose racemes, large for the size of the plant: pod inflated below, compressed at the summit, shorter than the style, densely clothed with stellate hairs. — W. Wyoming and S. W. Montana.

15. SUBULARIA, L. AWLWORT.

A dwarf stemless aquatic, smooth, with tufted subulate leaves, few minute white flowers, and no style.

1. *S. aquatica*, L. Scapes 1 to 3 inches high: leaves usually shorter than the scapes: flowers scattered: petals not exserted: pods obtuse, about equalling the pedicels. — In great abundance at the head of Yellowstone Lake, *Parry*. The next stations to the east are in New Hampshire and Maine.

16. CAPSELLA, Mœnch. SHEPHERD'S PURSE.

Slender and mostly smooth annuals, with small white flowers and simple or pinnate leaves.²

1. *C. divaricata*, Walp. Glabrous, very slender and diffusely branched: radical leaves pinnate or pinnatifid with few lobes; the upper oblanceolate to linear, entire: pods elliptic-oblong, on very slender spreading pedicels. — Colorado, W. Wyoming, and westward.

¹ *Camelina sativa*, Crantz., is an annual, with lanceolate arrow-shaped leaves, and large margined pods — Known as "False Flax," and introduced in Colorado, etc.

² *C. Bursa-pastoris*, Mœnch, is usually somewhat hirsute at base, with radical leaves mostly runcinate-pinnatifid, cauline lanceolate and auricled at base, and pods cuneate-triangular, truncate above. — Naturalized wherever civilized man is found.

17. **THLASPI**, L. PENNYCRESS.

Pod usually emarginate. Style rather long. Seeds somewhat turgid. — Low glabrous herbs with simple stems; lower leaves rosulate, entire or toothed, the cauline oblong, auricled and clasping; flowers white or pinkish.

1. **T. alpestre**, L. Radical leaves petioled, ovate or obovate: pods acutely margined but not winged. — *T. cochleariforme*, DC., of Hayd. Rep. 1872; *T. Fendleri*, Gray, of Hayd. Rep. 1870. From New Mexico to British America and westward.

18. **LEPIDIUM**, L. PEPPERGRASS.

Low herbs with pinnatifid or toothed leaves and small white flowers.

* *Petals none: stamens 2 or 4.*

1. **L. intermedium**, Gray. Erect and branching, puberulent or glabrous: lower leaves toothed or pinnatifid; the upper often entire, oblanceolate or linear: pod smooth or rarely puberulent, very shortly winged with somewhat divergent obtuse teeth, on spreading pedicels. — *L. rudrale* of Hayd. Rep. 1870. From Texas to Hudson Bay, and westward to S. California and the Columbia Valley. Forms with small petals are reported from Utah, New Mexico, Texas, etc.

** *Petals conspicuous: stamens 6.*¹

2. **L. montanum**, Nutt. Decumbent, branches many from a long somewhat woody root, spreading in a circular manner: radical leaves more or less bipinnatifid; upper leaves trifid or entire: pods indistinctly reticulated, elliptical, slightly emarginate, wingless, with a conspicuous style. — Plains from New Mexico to the British boundary, and in California.

3. **L. alyssoides**, Gray. Stems diffuse, branches minutely puberulent: leaves narrowly linear, mucronulate, attenuate at base, very entire, lowest often pinnately lobed: racemes dense, corymbose: pods ovate, shortly winged above with acutish teeth, scarcely emarginate, with a very short style. — In dry valleys and on hillsides from N. Nevada through Colorado to Mexico.

4. **L. Fremontii**, Watson. Glabrous and glaucous, diffusely branched, from a somewhat woody base: leaves linear, entire or sparingly lobed: racemes rather short and few-flowered: pods rounded, abruptly cuneate at base, slightly emarginate with short very obtuse teeth. — Bot. King's Exp. 30, with plate. S. Colorado and through S. Utah to Nevada and California.

19. **PHYSARIA**, Nutt.

Low and stellately canescent plants, distinguished by the inflated, nearly globular cells of the didymous pod.

1. **P. didymocarpa**, Gray. Decumbent, diffusely branched: radical leaves broadly spatulate, occasionally lyrate; cauline oblanceolate: flowers showy: pods deeply emarginate above and below, the cells usually approximate, but sometimes divergent. — From Colorado to British America and westward to the Sierra Nevada.

¹ *L. sativum*, L., has leaves variously divided and cut, with very numerous round-oval winged pods, and flowers sometimes rose-color. — Introduced in Colorado, Utah, and elsewhere

20. BISCUTELLA,¹ L.

Erect stellate-pubescent branching herbs, with entire or pinnatifid leaves, and yellow or purplish flowers.

1. **B. Wislizeni**, Benth. & Hook. A foot or more high, covered throughout with a fine, but dense, stellate pubescence: leaves linear-lanceolate to broadly lanceolate, entire, slightly undulate or deeply pinnatifid: each half of the pod roundish — *Dithyrea Wislizeni*, Engelm., of the various Western reports. S. W. Colorado, *Brandegee*, to Arizona and Texas.

ORDER 7. CAPPARIDACEÆ. (CAPER FAMILY.)

Herbs, with alternate leaves and perfect hypogynous flowers, sepals and petals as in *Cruciferae*, stamens 6 or more, nearly equal in length, pod one-celled with 2 parietal placentæ and kidney-shaped seeds, the embryo incurved rather than folded.

* Stamens 8 to 32.

1. **Polanisia**. Flowers whitish or purple. Pod elongated.

** Stamens 6.

2. **Cleome**. Flowers yellow or pink-purple. Pod oblong or linear, many-seeded.

3. **Cleomella**. Flowers yellow. Pod rhomboidal, 2-horned or globular, few-seeded.

1. POLANISIA, Raf.

Sepals sometimes united at base. Petals with claws and emarginate. Pod compressed or cylindrical, many-seeded. — Annual herbs, ill-scented and mostly glandular, with 3-foliolate petioled leaves, and flowers in leafy bracted racemes.

1. **P. trachysperma**, Torr. & Gray. *Leaves with 3 lanceolate leaflets; floral bracts mostly simple; petals with slender claws as long as the sepals; stamens 12 to 16, exerted; pod very rarely on a short slender stipe; seeds finely pitted and often warty.* — *P. uniglandulosa* of the Fl. Colorado and Bot. King's Exp. Colorado and Wyoming to the Columbia River, and eastward to Kansas and Texas.

2. **P. graveolens**, Raf. *Leaves with 3 oblong leaflets; flowers small; calyx and filaments purplish; petals yellowish-white; stamens about 11, scarcely exceeding the petals; pod slightly stipitate.* — Upper Arkansas Valley, Colorado, and eastward across the continent.

2. CLEOME, L.

Sepals sometimes united at base. Pod stipitate, many-seeded. — Erect branching annuals, with palmately 3 to 7-foliolate leaves, flowers in bracteate racemes, and pods pendent on spreading pedicels.

¹ *Raphanus sativus*, L., is more or less hispid, with purple or rose-colored flowers, and an inflated long-pointed pod. — The common Radish, running wild in cultivated grounds.

1. **C. lutea**, Hook. Smooth or slightly pubescent, 1 to 2 feet high: leaflets 5, linear- to oblong-lanceolate: flowers showy, bright yellow, corymbose, the raceme elongated in fruit: stamens much exserted: pod equalling or much longer than the stipe. — *C. aurea*, Nutt. Abundant in the valleys of Colorado and Wyoming, and westward to Nevada and Oregon.

2. **C. integrifolia**, Torr. & Gray. Somewhat glaucous, 2 to 3 feet high: leaflets 3, lanceolate (the lowest oblong): flowers large, showy, reddish-purple, rarely white, the raceme sometimes nearly a foot long: pods compressed, much longer than the stipe. — From Colorado to the Upper Missouri and eastward.

3. **C. Sonoræ**, Gray. Glabrous: leaflets 3, linear: flowers purplish: pod turpid, somewhat longer than the stipe, which is much shorter than the pedicel. — Pl. Wright. ii. 16. S. Colorado (*Brandegee*) and southward.

3. CLEOMELLA, DC.

Like *Cleome*, but the pod few-seeded, small and ovoid-globose or rhomboidal. — Erect branching annuals, with yellow racemose flowers and 3-foliate leaves.

1. **C. angustifolia**, Torr. Branching above: leaflets oblong-linear: pod many times longer than the style, shorter than the stipe, dilated-rhomboid: seeds transversely rugulose. — Colorado and southward. Distributed in the earlier Colorado collections by mistake under the name of *C. tenuifolia*.

2. **C. oöcarpa**, Gray. Diffuse: leaflets oblong-linear: raceme frequently densely flowered: pod with a somewhat shorter style, much shorter than the stipe, ovate: seeds 1 or 2, smooth. — Proc. Am. Acad. xi. 72. On the borders of the Mesa Verde, S. W. Colorado; also in Nevada.

ORDER 8. VIOLACEÆ. (VIOLET FAMILY.)

Herbs, distinguished by the irregular one-spurred corolla of 5 petals, 5 stamens, adnate introrse anthers conniving over the pistil, which has a single club-shaped style, a one-celled ovary with 3 parietal placentæ. — Flowers perfect, with persistent sepals. Each of the 3 valves of the capsule, after dehiscence, in drying firmly folds together lengthwise and by its increasing pressure projects the obovate seeds.

1. **Viola**. Sepals auricled. Lower petal spurred at base.

2. **Ionidium**. Sepals not auricled. Lower petal unguiculate, the claw dilated and shortly gibbous or concave.

1. VIOLA, L. VIOLET.

Anthers often coherent, the connectives of the two lower bearing spurs which project into the spur of the petal. — Mostly perennial herbs with alternate leaves, foliaceous persistent stipules, and 1-flowered axillary peduncles. The later flowers are often cleistogamous.

* *Stemless, the leaves and scapes all from a subterranean rootstock: flowers purplish or violet (sometimes white).*

1. **V. palustris**, L. Smooth: rootstock slender: leaves round heart-shaped and kidney-form, slightly crenate: flowers small, pale lilac with purple streaks, nearly beardless: spur very short and obtuse. — Mountains of Colorado and Utah, and far northward; also in the White Mountains of N. H.

2. **V. cucullata**, Ait. Rootstock thick and branching, dentate: leaves long-petioled, smooth or pubescent, cordate with a broad sinus; the lowest, often reniform and the later acute or acuminate, crenately toothed, the sides rolled inward when young: flowers deep or pale violet or purple (sometimes white: the lateral and often the lower petals bearded: spur short and thick. — A very variable species, ranging across the continent, but sparingly reported from the Rocky Mountain region of Colorado and Wyoming.

3. **V. delphinifolia**, Nutt. Rootstock short and very thick, erect, not scaly: leaves all palmately or pedately 5 to 7-parted; divisions 2 to 3-cleft into linear lobes: flowers pale or deep lilac-purple or blue: lateral petals bearded. — From Colorado across the plains to the Mississippi States.

* * *Leafy-stemmed, perennial from short rootstocks.*

+ *Leaf-bearing from base to summit, erect or ascending.*

++ *Flowers white or purple.*

4. **V. canina**, L., var. **sylvestris**, Regel. Low (3 to 8 inches high): stems mostly simple, from the base at length producing creeping branches: leaves heart-shaped or the lowest kidney-form, crenate; stipules fringe-toothed: petals light violet, the lateral ones slightly bearded: spur cylindrical, half the length of the petals: stigma beaked. — The most common American variety of this very variable and widely distributed species. From Colorado northward and eastward.

Var. **adunca**, Gray. Leaves ovate, often somewhat cordate at base, obscurely crenate: spur as long as the sepals, rather slender, hooked or curved. — Rocky Mountains and westward.

Var. **longipes**, Watson. Very similar, but the stout obtuse spur is nearly straight. — Bot. Calif. i. 56. Same range as the last.

5. **V. Canadensis**, L. Upright, 1 to 2 feet high: leaves cordate, pointed, serrate; stipules entire: petals white or whitish inside, the upper ones mostly tinged with purple beneath, sometimes entirely purple; the lateral ones bearded: spur very short: stigma beakless. — Colorado, Montana, Wyoming, and eastward.

++ ++ *Flowers yellow, more or less veined or tinged with purple.*

6. **V. aurea**, Kellogg. More or less pubescent, 2 to 6 inches high: leaves ovate to lanceolate, cuneate or sometimes truncate at base, coarsely crenate; stipules foliaceous, lanceolate, lacinate: peduncles a little longer than the leaves: the upper petals more or less tinged with brown on the outside, the others veined with purple: capsule nearly globular, pubescent.

Var. **venosa**, Watson. Alpine and more slender: flowers smaller: leaves often purple-veined. — Bot. Calif. i. 56. *V. Nuttallii*, var. *venosa*, of Hayd. Rep. 1872. The species belongs to the Sierra Nevada and westward, while the variety ranges eastward to the Wasatch and Uintas.

7. **V. Nuttallii**, Pursh. From densely pubescent to nearly glabrous: leaves oblong-ovate to oblong, *attenuate into the long petiole, entire or obscurely sinuate; stipules mostly narrow, entire: peduncles usually shorter than the leaves: capsule ovate, smooth.* — From Colorado to the Upper Missouri and Washington; also in California.

+ + Stems naked below, two-leaved above.

8. **V. biflora**, L. Stem weak, 2-leaved and 2-flowered: leaves reniform, very obtuse, crenate; stipules ovate, very entire: flowers very small, yellow: petals marked with brown lines: spurs short. — Colorado.

2. IONIDIUM, Vent.

Petals very unequal, the two upper shorter, the lower one very large. Stamens approximate, the anterior ones each furnished with a nectariferous gland at the base. — Leaves opposite or alternate; peduncles axillary, solitary.

1. **I. lineare**, Torr. Somewhat pubescent: leaves entire or remotely serrulate; the lower varying from lanceolate to oblong or obovate; the upper linear; stipules linear: peduncles articulated, bibracteolate: flowers small. — From Colorado eastward and southward across the plains.

ORDER 9. POLYGALACEÆ. (MILKWORT FAMILY.)

Herbs with simple entire leaves and no stipules, remarkable for the seemingly papilionaceous flowers, monadelphous or diadelphous stamens coherent with the petals, and one-celled anthers opening at the top.

1. POLYGALA, Tourn. MILKWORT.

Sepals 5, very unequal, the 2 lateral large and petal-like. Petals 3, united to each other and to the stamen-tube, the middle one hooded above and often crested or beaked. Stamens 6 or 8. Ovary 2-celled: style long, curved, dilated above. Capsule membranaceous, flattened contrary to the narrow partition, often notched above. Seed carunculate at the hilum. — Herbaceous or somewhat shrubby, with racemose or spicate flowers.

1. **P. verticillata**, L. Slender, 6 to 10 inches high: *stem-leaves whorled in fours, sometimes in fives; those of the branches scattered, linear: spikes peduncled, dense, slender; the bracts falling with the flowers, which are small, greenish-white or barely tinged with purple, the crest of the keel conspicuous: the 2-lobed caruncle half the length of the seed.* — Colorado and eastward across the plains.

2. **P. alba**, Nutt. Smoothish, one foot high, leafy half-way to the summit: *leaves linear to oblanceolate, margins slightly revolute: flowers deciduous, leaving the rachis roughened after their fall, white: seed with caruncle extended into two ear-like lobes nearly as long as the seed.* — Plains of the Upper Missouri.

3. **P. acanthoclada**, Gray. Somewhat shrubby, 2 feet high, *subcinereous-pubescent, armed with slender spines: leaves linear-spatulate: flowers subaxillary, scattered, white; pedicels bibracteolate at base: keel short boat-shaped, with a boss on the back.* — Proc. Am. Acad. xi. 73. S. W. Colorado and S. E. Utah.

ORDER 10. FRANKENIACEÆ.

Low perennial herbs or undershrubs, with opposite entire leaves and no stipules; distinguished from *Sileneæ* mainly by the parietal placentæ and oval or oblong anatropous seeds with a straight embryo.

1. FRANKENIA, L.

Calyx tubular or prismatic, 4 or 5-lobed. Petals 4 or 5, clawed and bearing a crown. Stamens 6. Ovary 1-celled: style 2 to 4-cleft into filiform divisions. Capsule included in the persistent calyx. — Leaves small, mostly crowded, and also fascicled in the axils: flowers small, solitary and sessile in the forks of the stem or becoming cymose-clustered on the branches, white.

1. **F. Jamesii**, Torr. Much branched from a woody base, 6 to 10 inches high: leaves linear, strongly revolute on the margins, the fascicled ones shorter: limb of petals erose-denticulate at tip. — S. Colorado.

ORDER 11. CARYOPHYLLACEÆ. (PINK FAMILY.)

Herbs, with regular and mostly perfect flowers, 4 or 5 persistent sepals, 4 or 5 petals (sometimes wanting), the distinct stamens commonly twice as many, ovary one-celled with a free central placenta, the seeds reniform. — Stems usually swollen at the nodes. Leaves opposite. Styles 2 to 5, mostly distinct. Fruit a capsule opening by valves, or by teeth at the summit. Stipules none in our genera.

Tribe I. Sepals united. Petals with a conspicuous claw, usually with an appendage (crown) at the base of the blade, borne with the stamens on a stipe under the ovary. Capsule dehiscent at the toothed summit. Flowers comparatively large. — *SILENEÆ*.¹

1. **Silene**. Calyx 5-toothed. Styles 3.

2. **Lychnis**. Calyx 5-toothed or 5-lobed. Styles 4 or 5.

Tribe II. Sepals distinct or nearly so. Petals without crown or distinct claw, inserted with the stamens on the margin of a disk under the sessile ovary, sometimes inconspicuous or wanting. — *ALSINEÆ*.

* Styles (when of the same number) opposite the sepals.

3. **Cerastium**. Capsule cylindric, opening at the toothed apex. Petals emarginate or bifid. Styles usually 5.

4. **Stellaria**. Capsule short, splitting to the base. Petals 2-cleft or none. Styles mostly 3.

5. **Arenaria**. Differs from the last chiefly in the entire petals, these rarely wanting.

* * Styles alternate with the sepals and of the same number.

6. **Sagina**. Capsule 4 or 5-valved. Petals entire or wanting. Styles 4 or 5.

1. SILENE, L. CATCHFLY.

Calyx tubular, 10-nerved. Petals entire, notched, or bifid. Capsule usually 6-toothed. — Annual or mostly perennial herbs.

¹ *Saponaria*, an introduced genus, has a terete calyx, petals not crowned, and two styles. *S. Vaccaria*, L., is a smooth annual, with ovate-lanceolate leaves, pale red flowers in corymbed cymes, and calyx enlarged and wing-angled in fruit. — *Vaccaria vulgaris* of Gray's Manual. Very generally introduced.

* *Annual: flowers in naked panicles: petals entire or obcordate, crowned.*

1. **S. antirrhina**, L. Glabrous, with a part of each joint viscid, erect, slender: leaves lanceolate or linear: flowers in a dichotomous panicle, on long pedicels: calyx becoming expanded by the enlarging ovary: petals pink. — From S. Colorado to British America and eastward across the continent; also in California.

* * *Perennial: petals bifid.*

+ *Peduncles 1-flowered: stems spreading or decumbent.*

2. **S. Menziesii**, Hook. Glandular-puberulent: stems dichotomously branched, leafy: leaves ovate-lanceolate or -oblong: peduncles lateral and terminal, equalling the leaves: petals without a crown: seeds minutely tuberculate, at length nearly black and shining. — From New Mexico to Slave Lake and westward to California.

+ + *Peduncles 3- to many flowered: stems erect.*

3. **S. multicaulis**, Nutt. Minutely pubescent: stems numerous, about a foot high, rigid: leaves linear-ob lanceolate; upper ones very small: flowers in threes on shortish peduncles, pale red: calyx ovate-cylindrical: seeds brown, margined with a scaly crest. — From the western slopes of the mountains to the Pacific.

4. **S. Douglasii**, Hook. Minutely pubescent: stem simple, very slender, 2 to 3 feet high: leaves remote, linear, elongated: flowers few on slender peduncles, rose-color or nearly white: calyx obovate, at length inflated and membranaceous, pubescent. — Montana to Washington and southward to California and the Wasatch.

5. **S. Scouleri**, Hook. Stem stout: leaves distant, narrow: racemes sub-compressed, narrow, few-flowered: calyx somewhat dilating, the teeth broad-lanceolate, slightly ciliate: petals white or pinkish, the broad hind limb with notched lobes and appendages: claws awicled, woolly-ciliate as well as the filaments. — In the mountains from New Mexico to British America.

* * * *Perennial, dwarf, tufted, smooth: flowering shoots 1-flowered: petals notched or entire, crowned.*

6. **S. acaulis**, L. Tufted like a moss: leaves linear, crowded: flowers almost sessile, or rarely on a naked peduncle: petals purple or rarely white. — Alpine summits of the whole Rocky Mountain range, and northward to Arctic America: also in the White Mountains of N. H.

2. **LYCHNIS**, L. COCKLE.

Calyx more or less inflated, capsule 5 to 10-toothed, and styles as many as calyx-lobes; otherwise nearly as in *Silene*. — Ours are perennials with linear to oblanceolate leaves.

* *Stems 1-flowered: seeds with a loose membranous margin: dwarf and caespitose, alpine.*

1. **L. montana**, Watson. Glandular-pubescent above, nearly glabrous below: petals included or nearly so, the emarginate blade not broader than the very narrow claw: appendages very small: seeds rather broadly margined. — The *L. apetala* of the Fl. Colorado and other Western reports. Mountain peaks of Colorado, and in the Uintas

2. **L. Kingii**, Watson. *Pubescent throughout: petals exserted, the short and flat blade rather deeply emarginate; appendages entire or toothed; claw ciliate, rather broadly auricled; filaments ciliate.* — *L. Ajanensis?* of Bot. King's Exp. 37. Peaks of the Uintas and in N. W. Wyoming.

* * *Flowers rarely solitary; seeds tuberculate.*

3. **L. Drummondii**, Watson. *Rather stout, finely glandular-pubescent above: leaves narrowly oblanceolate; flowers few, on stout often elongated pedicels: petals included or nearly so, white or purple, the entire or emarginate blade narrower than the auricled claw; appendages minute.* — *Silene Drummondii* of the earlier Reports. Colorado, Wyoming, and northward.

4. **L. Parryi**, Watson. *Slender, finely glandular-pubescent above: leaves linear: flowers with the lateral pedicels mostly short: petals long-exserted, purplish, the broad blade cleft to the middle and with a short narrow lobe on each side; appendages quadrate or ovate, crenate; claw broadly auricled.* — Proc. Am. Acad. xii. 248. N. W. Wyoming, Parry.

3. CERASTIUM, L. MOUSE-EAR CHICKWEED.

Stamens 10. Capsule often incurved, thrice the length of the calyx. — Mostly pubescent or hirsute low herbs: flowers white, in terminal leafy or scariously bracted dichotomous cymes.

1. **C. nutans**, Raf. *Annual, viscid-pubescent, erect: leaves narrowly oblong or linear-lanceolate, clasping, the lowest spatulate: cyme open, rather many-flowered: pedicels often nodding or reflexed in fruit: petals slightly longer than the sepals: capsule curved.* — Across the continent and southward into northern Mexico.

2. **C. alpinum**, L. *Silky-hirsute, decumbent, few-flowered: leaves elliptical-ovate: peduncles more or less elongated: petals bifid, twice the length of the hairy sepals: capsule nearly twice as long as the calyx.*

Var. **Behringianum**, Regel. *Petals and capsule half longer than the calyx, shorter than the pedicels: stems 2 to 4-flowered.* — *C. vulgatum*, var. *Behringianum*, of Fl. Colorado, Hayd. Rep. 1872, and Bot. King's Exp. Mountains of Colorado and W. Wyoming.

3. **C. arvense**, L. *Perennial, downy with reflexed hairs, caespitose: leaves linear to linear-lanceolate, clasping: cyme few-flowered: pedicels erect or nodding: petals nearly twice longer than the sepals: capsule little exceeding the calyx, nearly straight.* — Colorado and northward through Utah, Montana, and Wyoming, and across the continent.

4. STELLARIA, L. CHICKWEED.

Stamens 10 or fewer. Styles 3, or rarely 2, 4, or 5. Capsule globose to oblong. — Low herbs, mostly diffuse: leaves rarely subulate: flowers white, solitary or cymose: stems mostly 4-angled.

* *Bracts small and scarious.*

+ *Petals none.*

1. **S. umbellata**, Turcz. *Glabrous: stems very slender, ascending from slender creeping rootstocks, which are covered with orbicular scales: leaves*

elliptic or oblong lanceolate: flowers in a simple or compound open umbel-like few-rayed cyme: pedicels elongated. — Gray, Proc. Acad. Philad. 1863, 59. Mountains of Colorado and northward.

+ + *Petals equalling or surpassing the calyx.*

2. **S. longifolia**, Muhl. Stem erect, weak, often with rough angles: leaves linear, acutish at both ends, spreading: cymes naked and at length lateral, peduncled, many-flowered; the slender pedicels spreading. — From Oregon to British America and across the continent.

3. **S. longipes**, Goldie. Shining or somewhat glaucous, very smooth: leaves ascending, lanceolate or linear-lanceolate, broadest at the base: cyme terminal, few-flowered; the long pedicels erect. — Colorado and northward, thence eastward to Wisconsin and Maine.

Var. **læta**, Torr. & Gray. Branches erect from creeping stems, 3 to 6 inches high: leaves erect, rigid, carinate: sepals rather obtuse. — With the last, in the mountains.

Var. **Edwardsii**, Torr. & Gray. Branches an inch or two high: leaves ovate-lanceolate (the lowest sometimes ovate), sometimes sparsely ciliate at the base: sepals acutish. — Mountains of Colorado.

* * *Bracts foliaceous.*

+ *Petals shorter than the sepals, or none.*

4. **S. borealis**, Bigelow. Erect or spreading: leaves elongated, lance-linear, finely serrulate, the intramarginal nerve very indistinct: flowers in dichotomous cymes: seeds smooth. — Abundant in the mountains of Colorado and northward, and across the continent.

5. **S. obtusa**, Engelm. Like the last, but prostrate; leaves triangular-ovate, smooth-edged, 1-nerved, and the delicate reticulated veins uniting into distinct intramarginal nerves: seeds (under the lens) covered with oblong-linear pectinate tubercles. — Bot. Gazette, vii. 5. W. Colorado on the tributaries of the Gunnison River, Brandegee; also in British Columbia.

+ + *Petals exceeding the sepals (sometimes wanting in No. 6).*

6. **S. crassifolia**, Ehrhart. Stems diffuse or erect, flaccid: leaves rather fleshy, varying from linear-lanceolate to oblong: flowers terminal or in the forks of the stem or of leafy branches: seeds rugose-roughened. — Colorado, Montana, and eastward to the Ohio valley.

7. **S. Jamesii**, Torr. Somewhat viscidly pubescent, rather stout: leaves linear to ovate-lanceolate: pedicels divaricate: seeds smooth. — New Mexico, Colorado, and westward.

5. ARENARIA, L. SANDWORT.

Styles 3. Capsule globose or short-oblong. — Mostly low annuals or perennials, usually tufted: with sessile leaves, often subulate and more or less rigid: flowers white, cymosely paniced or capitate.

§ 1. *The 3 valves of the capsule 2-cleft or parted: seeds not appendaged at the hilum: caespitose perennials, mostly scarious-bracted.* — **ARENARIA** proper.

* *Petals exceeding the sepals.*

1. **A. congesta**, Nutt. Smooth and glaucous: leaves very narrowly subulate, scabrous on the margin, often pungent: flowers in 1 to 3 dense subumbellate

fascicles, with large dilated membranous bracts: petals nearly twice as long as the sepals: *stigmas capitate*. — Mountains of Colorado, Utah, and Wyoming, to Washington.

Var. **subcongesta**, Watson. Flowers less densely fascicled and somewhat cymosè. — Bot. Calif. i. 69. *A. Fendleri*, var. *subcongesta*, of Bot. King's Exp. and Fl. Colorado. Colorado, S. Idaho, and westward.

2. **A. capillaris**, Poir., var. **nardifolia**, Regel. *More or less glandular-pubescent above*: leaves linear subulate, pungent: *flowers few in an open cyme*; bracts small, lanceolate: petals half longer than the sepals. — Watson in Bot. Calif. i. 69. *A. nardifolia*, Ledeb., and *A. formosa*, Hook., in Bot. King's Exp. 39. From the British boundary southward to the Wasatch and California.

* * *Petals about equalling the calyx.*

3. **A. saxosa**, Gray. *Slightly-hispid pubescent*: leaves lanceolate: *raceme many-flowered, somewhat cymose*: sepals with a distinct almost keel-like hispid midrib. — Pl. Wright, ii. 18. S. Colorado and southward.

4. **A. pungens**, Nutt. *Pubescent throughout, caespitose*: leaves linear-subulate, pungent, crowded: *flowers in an open cyme, leafy-bracted*: sepals acuminate, pungent: seeds very few, smooth. — W. Wyoming, Teton Mountains, and westward to California.

5. **A. Franklinii**, Dougl. Of similar habit, *but stouter and less pubescent*: stems leafy at base: *flowers fascicled in a rather close cyme*: sepals smooth and shining, scariously margined, as also the large bracts. — From Colorado to the sources of the Missouri and westward to Oregon.

Var. **minor**, Hook. & Arn. With shorter leaves, bracts, and sepals; the last two membranaceous. — W. Wyoming, Parry.

6. **A. Fendleri**, Gray. *Stems numerous from a perennial caudex, glabrous below, more or less glandular-pubescent above, imbricately many-leaved at base*: leaves long, somewhat flattened, serrulate-scarious, smooth except on the margins: *cymes strict and few-flowered*: sepals acuminate, with a broad scarious margin: seeds papillose-scarious. — Pl. Fendl. 13. Montana, Colorado, and southward.

Var. **glabrescens**, Watson. *Nearly glabrous throughout*: sepals shorter, acute: leaves short. — Bot. King's Exp. 40. Colorado and westward to Nevada.

Var. **diffusa**, Porter. *Branches of the cyme elongated, lax and widely spreading*: flowers numerous. — Fl. Colorado, 13. Ute Pass, Colorado, Porter.

§ 2. *The 3 valves of the capsule entire*: seeds not appendaged at the hilum. Ours are all caespitose, not more than 3 inches in height, usually 1 to few-flowered, and with petals commonly exceeding the sepals. — ALSINE.

7. **A. verna**, L. *Erect, pubescent or glabrous*: leaves linear-subulate, *nerved, erect*: cyme erect: sepals ovate, acute, mostly a little longer than the petals. — Mountains of Colorado, Uintas, Teton Range, and northward to Arctic America.

Var. **hirta**, Watson. Leaves minutely hirsute, obtuse. — Bot. King's Exp. 41. With the last.

8. **A. biflora**, var. **carnosula**, Watson. *Stems creeping; branches mostly 1-flowered: leaves narrowly linear, nerveless: sepals linear, very obtuse, cucullate at the summit: petals much longer than the sepals and capsule.* — Bibl. Index, i. 94. *A. alpina* of the Fl. Colorado. Colorado.

Var. **obtusa**, Watson. *Leaves obtuse, carinate, serrulate-ciliate, obscurely 3-nerved: peduncles glandular-pubescent: petals about half longer than the oblong sepals.* — Watson, l. c. *A. arctica* of Hayd. Rep. for 1870–72, and *A. arctica*, var. *obtusa*, of Bot. King's Exp. and Fl. Colorado. Abundant in the mountains of Colorado, the Uintas, about Yellowstone Lake, and northward throughout the Arctic regions.

9. **A. stricta**, Watson. *Leaves subulate-triangular, rather obtuse, scarcely equalling the flower or exceeding the calyx, mostly shorter than the internodes, with manifest lateral nerves: peduncles 1-flowered: petals sometimes wanting.* — Watson, l. c. *Alsine stricta*, Wahl. *A. Rossii* of Hayd. Rep. 1870 and Fl. Colorado. *A. stricta*, Michx., of the Eastern Flora, becomes *A. Michauxii*, Hook. Colorado, Wyoming, and northward.

§ 3. *Parts of the flower sometimes in fours: valves of the capsule bifid: young ovary 3-celled: seed appendaged at the hilum with a small caruncle.* — MÖHRINGIA.

10. **A. lateriflora**, L. Sparingly branched, erect, minutely pubescent: *leaves oval or oblong, obtuse: peduncles usually 2-flowered, soon becoming lateral: sepals oblong, obtuse: petals exerted.* — From Colorado to Alaska, and eastward across the continent.

11. **A. macrophylla**, Hook. Stems ascending, mostly simple, puberulent above: leaves 3 to 4 pairs, narrowly lanceolate, acute at each end, bright green: flowers few on slender pedicels: sepals ovate-oblong, acuminate: *petals included.* — From the Bitter Root Mountains to Washington and California; also in New Mexico.

6. SAGINA, L. PEARLWORT.

Low green herbs, with subulate or filiform glabrous leaves, and small terminal usually long-pedicelled flowers.

1. **S. decumbens**, Torr. & Gray. Stems decumbent, ascending: *leaves somewhat secund, mucronate: peduncles much longer than the leaves: petals as long as the sepals: stamens 5 to 10.* — Including *S. subulata*, Torr. & Gray, of Gray's Manual, where the species is credited to Wimmer. Rocky Mountains and eastward.

2. **S. Linnæi**, Presl. *Densely matted and decumbent, an inch or two high: leaves somewhat fasciated, pungent: flowers on long pedicels, at length nodding: sepals exceeding the petals: stamens 10.* — *Spergula saginoides*, L. From New Mexico to Arctic America.

3. **S. nivalis**, Lindb. *Cespitose, stems very short, scarcely $\frac{1}{2}$ inch high: leaves mucronate: peduncles short, strict: sepals with membranous margins, scarcely equalling the petals.* — Uinta Mountains, Watson.

ORDER 12. **PORTULACACEÆ.** (PURSLANE FAMILY.)

More or less succulent herbs, with simple and entire leaves (either opposite or alternate) and regular but unsymmetrical perfect flowers; sepals (except in *Lewisia*) 2; petals 2 to 5 or more; stamens opposite the petals or numerous; ovary one-celled, in fruit becoming capsular; style 2 to 8-cleft; stipules none or scarious or reduced to hairs. Flowers open only in sunshine or bright daylight.

* Sepals 2, united below and adherent to the ovary, the free upper portion at length deciduous.

1. **Portulaca.** Stamens 7 to 20. Flowers solitary, yellow (in ours). Capsule opening by a lid.

* * Sepals 2, distinct, persistent (deciduous in *Talinum*): ovary free.

+ Style 3-cleft: capsule 3-valved: sepals equal.

2. **Talinum.** Stamens 10 to 30. Petals 5. Seeds numerous.

3. **Calandrinia.** Stamens more than 5. Petals 5 or more. Seeds mostly smooth and shining.

4. **Claytonia.** Stamens 5. Petals 5. Seeds smooth and shining.

+ + Style 2-cleft: capsule 2-valved: sepals unequal, hyaline.

5. **Spraguea.** Stamens 3. Petals 4. Stems simple, scape-like.

6. **Calyptridium.** Stamen 1. Petals 2. Stems branching, leafy.

* * * Sepals 4 to 8, distinct, much imbricated.

7. **Lewisia.** Stamens many. Style 3- to 8-cleft. Petals 8 to 16. Scapes 1-flowered.

1. PORTULACA, Tourn. PURSLANE.

Petals 4 to 6. Style deeply 3- to 8-cleft. — Fleshy diffuse or ascending annuals, with axillary or terminal ephemeral yellow (in ours) flowers.

1. **P. retusa**,¹ Engelm. Stems somewhat ascending, sometimes covering a space several feet in diameter: leaves flat, obovate to spatulate: sepals obtuse, broadly carinate-winged: seeds tuberculate. — S. W. Colorado and southward.

2. TALINUM, Adans.

Distinguished from *Calandrinia* by the deciduous sepals, the style less deeply 3-cleft, the capsule 3-celled at base when young, and the seeds on a globular stalked placenta.

1. **T. teretifolium**, Pursh. Leafy stems low, tuberous at the base: leaves linear, cylindrical: peduncle long and naked, bearing an open cyme of pink flowers. — In the mountains of Colorado and eastward.

3. CALANDRINIA, HBK.

Low succulent herbs, with radical leaves (in ours) and white to reddish ephemeral flowers in bracteate racemes or panicles, or few upon short scape-like stems.

¹ *P. oleracea*, L., is prostrate, not so green, with larger leaves, acute sepals, and seeds more finely tuberculate. — Common Purslane or Pig-weed; naturalized near dwellings.

1. *C. pygmæa*, Gray. Smooth, with a thick fusiform root: leaves linear, with broad scariously winged underground petioles: scapes mostly simple, *an inch or two high, with a pair of small scarious bracts: sepals glandular-dentate: petals red.* — Proc. Am. Acad. viii. 623. *Talinum pygmæum*, Gray. Alpine region, Rocky Mountains of Colorado and Wyoming to the Sierra Nevada in California and Cascade Mountains in Washington.

2. *C. Nevadensis*, Gray. Very similar, but *somewhat larger; with a pair of larger leafy bracts and entire somewhat longer sepals, white petals and more numerous ovules.* — In the Wasatch (*Watson*), probably in the Uintas, and westward.

4. CLAYTONIA, L. SPRING-BEAUTY.

Seeds few, black and shining. — Low glabrous succulent herbs, with opposite or alternate leaves, and white or rose-colored flowers in loose terminal or axillary and simple or compound naked racemes, or sometimes umbellate, not ephemeral.

* *Annuals, with fibrous roots.*

+ *Stems simple, bearing a single pair of leaves which are often connate.*

1. *C. perfoliata*, Donn. Radical leaves long-petioled, *broadly rhomboidal or deltoid or deltoid-cordate, obtuse; the cauline pair more or less united, usually forming a single somewhat orbicular perfoliate leaf, concave above: racemes usually nearly sessile and loosely flowered, the short pedicels often secund.* — From the Uintas and the Wasatch to California, and thence northward to Alaska.

2. *C. cordifolia*, *Watson*. Stem from a slender running rootstock: *radical leaves broadly cordate, acutish; cauline pair sessile, ovate, acute: racemes few-flowered, with slender pedicels: petals thrice longer than the rounded sepals.* — Proc. Am. Acad. xvii. 365. N. W. Montana (*Watson*), to Idaho and Oregon.

+ + *Stems usually branching, leafy.*

3. *C. Chamissonis*, *Esch.* Stems weak and slender, erect or decumbent, stoloniferous and rooting at the joints: leaves opposite, oblanceolate or spatulate: racemes few-flowered; the flowers very variable in size, on slender pedicels: petals white. — *C. aquatica*, *Nutt.* Abundant in Colorado and northward to the British boundary and westward. In the spray of the Lower Falls of the Yellowstone.

* * *Perennials, from a deep-seated tuber.*

4. *C. Caroliniana*, *Michx.* Radical leaves very few, spatulate; cauline ones a single pair, ovate-lanceolate or oval, subspatulate at the base or abruptly decurrent into a petiole: pedicels slender, nodding: flowers in a loose raceme: sepals and petals very obtuse, the latter pale rose-color with deeper veins. — In the Rocky Mountains and eastward to the Atlantic.

Var. *sessilifolia*, *Torr.* Radical leaf narrow; cauline sessile, lanceolate to linear: raceme nearly sessile and cymose, with a single scarious bract at base: sepals acutish. — *C. Caroliniana*, var. *lanceolata*, of Bot. King's Exp., Fl. Colorado, and the Hayden Reports. Colorado and northward, and westward to the Sierra Nevada.

* * * *Perennial, with a thickened caudex.*

5. **C. megarrhiza**, Parry. Root fusiform, very large: leaves fleshy; radical ones petioled; cauline lanceolate or linear-lanceolate, sessile: racemes secund: flowers large, profuse, white with pinkish veins: petals obovate, subemarginate. — Parry in Herb. Gray. *C. arctica*, var. *megarrhiza*, of Bot. King's Exp. and Fl. Colorado. High alpine, growing in crevices of the rock, its large purple tap-root penetrating to a great depth. Mountains of Colorado and the Uintas.

5. SPRAGUEA, Torr.

Sepals orbicular-cordate. — A glabrous biennial; with mostly radical fleshy leaves and ephemeral flowers in dense scorpioid spikes umbellate-clustered on a scape-like peduncle.

1. **S. umbellata**, Torr. Stems several from a thickened root, 2 to 12 inches high: radical leaves spatulate or oblanceolate, on thick petioles; the cauline similar but smaller, frequently scariously stipulate: an involucre of scarious bracts subtending the dense capitate umbel of nearly sessile spikes: flowers light rose-color: sepals very conspicuous, about equalling the petals. — Wyoming (*Parry*), Yellowstone Park (*Coulter*), and westward. Usually in dry rocky or sandy localities.

6 CALYPTRIDIMUM, Nutt.

Sepals broadly ovate or orbicular. Petals somewhat coherent at the apex. — Smooth prostrate diffusely branched annuals; with alternate succulent leaves and small ephemeral flowers in axillary or terminal, clustered or compound, scorpioid spikes.

1. **C. roseum**, Watson. Leaves oblong-spatulate, attenuate at base; radical leaves few or none: petals minute: capsule not exceeding the calyx. — Bot. King's Exp. 44, t. 6. W. Wyoming (*Parry*) and westward to California.

7. LEWISIA, Pursh.

Sepals broadly ovate, unequal, persistent. Petals large and showy. Style parted nearly to the base. — Low acaulescent fleshy perennials, caespitose, with thick fusiform roots.

1. **L. rediviva**, Pursh. Leaves densely clustered, linear-oblong, subterete, smooth and glaucous: scapes but little longer, jointed at the middle, and with 5 to 7 subulate scarious bracts verticillate at the joint: petals rose-colored or white. — Arizona, Utah, Wyoming, Montana (in the Bitter Root Mountains), and westward. The specific name refers to the fact that the roots are wonderfully tenacious of life.

ORDER 13. ELATINACEÆ. (WATER-WORT FAMILY.)

Low annuals, with membranous stipules between the opposite dotless leaves, regular and mostly symmetrical flowers (2 to 5-merous), with

free sepals, hypogynous petals and stamens, and distinct styles bearing capitate stigmas, the ovary 2 to 5-celled with axile placenta becoming capsular in fruit.

1. ELATINE, L. WATER-WORT.

Parts of the flower in twos, threes, or fours. Sepals membranaceous, obtuse. Ovary globose. — Small prostrate glabrous plants, growing in water or wet places, with entire leaves and usually solitary flowers. Gray, Proc. Am. Acad. xiii. 361.

1. **E. triandra**, Schkuhr. *Leaves oblanceolate or oblong-lanceolate, gradually attenuate at base: petals, stamens, and carpels most frequently 3, with 2 sepals: almost the seeds of the next, or more slender, less marked.* — On the Platte River, in Nebraska or Colorado (Hull); also in Illinois.

2. **E. Americana**, Arn. *Leaves obovate, very obtuse: flowers with their parts oftener in twos, sometimes in threes: seeds cylindraceous, somewhat curved, the crustaceous coat many- (20 to 30-) latticed in 9 to 10 lines.* — Colorado and Oregon, also on the Atlantic border.

ORDER 14. HYPERICACEÆ. (ST. JOHN'S-WORT FAMILY.)

Herbs (in ours), with opposite entire leaves punctate with translucent or dark-colored glandular dots, no stipules, and perfect flowers with 5 petals and numerous stamens, the fruit a many-seeded capsule. — Sepals 5, imbricate. Petals convolute, glandular-punctate. Stamens very numerous in 3 bundles. Styles 2 to 5.

1. HYPERICUM, L. ST. JOHN'S-WORT.

In our species the capsule is 3-celled by the union of the placenta with the axis, septicidal, and the flowers yellow with black dots.

1. **H. Scouleri**, Hook. *Stems erect from a running rootstock, simple or sparingly branched: leaves ovate to oblong, clasping: flowers in an open cyme: styles elongated.* — Colorado, Utah, southward and westward.

ORDER 15. MALVACEÆ. (MALLOW FAMILY.)

Mostly herbs, with mucilaginous juice, and alternate leaves with stipules; distinguished by the valvate calyx, convolute petals, their bases or short claws united with each other and with the base of a column of numerous monadelphous stamens, these with reniform 1-celled anthers. — Calyx 5-parted, often surrounded by an involucrel. Petals 5. Pistils a ring of ovaries around a projection of the receptacle. Leaves most commonly palmately ribbed. Peduncles axillary. Flowers often large and showy. In all of ours the staminal tube is anther-bearing at the top.

* Styles stigmatic down the inner side : carpels indehiscent : ovules solitary, ascending.¹

1. **Callirrhoe**. Bractlets 3, or none. Petals truncate. Carpels beaked.
2. **Sidalcea**. Bractlets none. Filaments in a double series, those of the outer series united in 5 clusters. Carpels fewer, beakless.

* * Stigmas capitate : carpels mostly dehiscent at least at the apex.

3. **Malvastrum**. Bractlets 1 to 3. Ovule solitary, ascending.
4. **Sphaeralcea**. Bractlets 1 to 3. Ovules 2, the lower ascending, the upper pendulous.
5. **Abutilon**. Bractlets none. Ovules 3 or more in each cell.

1. CALLIRRHOË, Nutt.

Petals wedge-shaped (usually red-purple). Carpels 10 to 20, with a short empty beak, separated within from the 1-seeded cell by a narrow projection.

1. **C. involucrata**, Gray. Hirsute: stem branching, procumbent: leaves deeply 3 to 5-parted, covered with stellate hairs, segments linear-lanceolate, laciniately 3 to 5-toothed: peduncles erect, 1-flowered, longer than the leaves: flowers few in a loose panicle, scarlet: bractlets linear-lanceolate: carpels hairy, not wrinkled. — Loup Fork of the Platte, S. E. Colorado, and southward.

2. **C. alcæoides**, Gray. Strigose-pubescent: stems slender: lower leaves triangular heart-shaped, incised; the upper 5 to 7-parted, laciniate; the uppermost divided into linear segments: flowers corymbose, rose-color or white: involucrel none: carpels crested and strongly wrinkled on the back. — Valley of the Platte, southward and eastward to Kentucky and Tennessee.

2. SIDALCEA, Gray.

Carpels 5 to 9, beakless. — Herbs, with rounded and mostly lobed or parted leaves, the usually purple flowers in a narrow terminal raceme or spike.

1. **S. malvæflora**, Gray. Lower leaves 7 to 9-lobed; cauline more narrowly and deeply 5 to 7-lobed; segments linear, somewhat toothed: pedicels at first shorter, at length longer than the subulate bracts: flowers purple or white: carpels 7, pointless. — From Mexico to Colorado and Oregon.

2. **S. candida**, Gray. Lower leaves orbicular, 7-lobed, segments coarsely 3 to 5-toothed or incised; upper leaves 7-lobed or parted; the segments lanceolate, entire: pedicels shorter than the bracts: flowers white or cream-color: carpels 9 or 10, cochleate-reniform, mucronate. — On water-courses in the mountains of Colorado and southward.

3. MALVASTRUM, Gray. FALSE MALLOW.

Staminal tube simple. Carpels 5 or more. — Herbaceous tufted perennials; the flowers in narrow naked or leafy subpaniculate racemes.

1. **M. coccineum**, Gray. Low and hoary: leaves 5-parted or pedate:

¹ *Malva*, an introduced genus, has 3 distinct bractlets, obcordate petals, and carpels rounded, beakless

M. rotundifolia, L., has procumbent stems, round heart-shaped crenate obscurely-lobed leaves on very long petioles, whitish petals twice the length of the sepals, and pubescent carpels. — The common Mallow. Commonly naturalized along waysides and in cultivated ground.

spikes or racemes of *showy pink-red flowers*. — Common on the plains from Colorado to British America, and eastward to Iowa and Minnesota.

2. **M. Munroanum**, Gray. *Taller, grayish or hoary-pubescent: leaves broadly ovate, usually cordate at base, 3 to 5-lobed or deeply cleft: flowers scarlet*. — Utah, Montana, and westward.

4. SPHÆRALCEA, St. Hilaire.

Differing from *Malcastrum* only in the two-ovuled cells of the ovary.

1. **S. angustifolia**, Spach. *Slender, erect, hoary-pubescent: leaves oblong to narrowly lanceolate, usually subcordate or rounded at base, crenate or coarsely toothed: flowers small*. — S. Colorado and southward.

2. **S. rivularis**, Torr. *Taller, scabrous with a stellate pubescence: leaves cordate, deeply 5 to 7-lobed, coarsely serrate: racemes leafy below, naked above; the flowers clustered on short peduncles, light purple or nearly white*. — *S. acerifolia* of the Hayden Reports for 1870-72 and Bot. King's Exp. W. Wyoming, northward and westward.

5. ABUTILON, Tourn. INDIAN MALLOW.

Herbs, usually soft-tomentose: flowers mostly axillary, yellow (in ours).

1. **A. parvulum**, Gray. *Cinereous tomentose: stems slender, spreading, paniculate above; branchlets pilose with spreading hairs: leaves small, cordate, dentate, sometimes 3-lobed, canescent, tomentose beneath: peduncles axillary, 1-flowered, longer than the leaf*. — Ledges of rock near Cañon City, Colorado (*Greene*), and southward.

ORDER 16. LINACEÆ. (FLAX FAMILY.)

Herbs, with the regular and symmetrical hypogynous flowers 4 to 6- (5 in ours) merous throughout, strongly imbricated calyx and convolute petals, the stamens monadelphous at the base, and the pod 8 to 10-seeded, having twice as many cells as there are styles.

1. LINUM, L. FLAX.

Styles often united into one below; ovary globose. Seeds flattened, ovate, the coat mucilaginous when wetted. — Herbs (sometimes shrubby at base) with tough fibres in the bark, sessile entire alternate leaves, no stipules, and cymose or panicle flowers.

* *Petals blue.*

1. **L. perenne**, L. *Branching above, leafy: leaves linear to linear-fanceolate, acute: flowers large, in few-flowered corymbs or scattered on the leafy branches: capsule exceeding the sepals, the prominent false partitions long-ciliate*. — Common on dry soils throughout our whole range, thence northward and westward.

* * *Petals yellow: sepals glandular-margined.*

2. **L. rigidum**, Pursh. *Stems angled, much branched: leaves linear, pungently-acute, rigid, with scabrous margins: pedicels thickened at the end and*

forming an exterior cup-shaped calyculus: petals sulphur-yellow: styles united almost to the top: capsule shorter than the sepals. — From S. Colorado to the Missouri River.

3. **L. Kingii**, Watson. Stems panicle above, shrubby at base: leaves linear or narrowly oblong, obtuse: styles distinct: capsule somewhat exceeding the sepals. — Bot. King's Exp. 49. Mountains of Utah.

ORDER 17. ZYGOPHYLLACEÆ.

Distinguished from allied orders by the opposite compound leaves, with interposed stipules and entire dotless leaflets. — Sepals 5, distinct. Petals hypogynous, imbricated in the bud. Stamens (in ours) twice as many as the petals and inserted with them. Ovary 5 to 12-celled, with a single terminal style. Fruit dry. — Ours are herbs or shrubs, with solitary flowers on lateral or terminal naked peduncles, and ovary surrounded at the base by a disk.

1. **Tribulus**. Leaves abruptly pinnate, 6 to 10-foliolate. Fruit tuberculate. Herbs.

2. **Larrea**. Leaves 2-foliolate. Fruit densely hairy. Heavy-scented shrubs.

1. TRIBULUS, L.

Sepals mostly persistent. Petals fugacious. Disk annular, 10-lobed. Stamens 10, the alternate filaments a little shorter and with a gland at base on the outer side. Ovary 5 to 12-celled. Fruit lobed, separating into roughly tuberculate carpels. — Loosely branched and hairy prostrate herbs, with apparently axillary white or yellow flowers.

1. **T. maximus**, L. Leaflets ovate-oblong, more or less oblique: sepals very hairy, linear, acuminate: fruit beaked by a stout style. — *Kallstromia maxima*, Torr. & Gray. Fremont County, Colorado (*Brandegee*), to S. California and Texas.

2. LARREA, Cav. CREOSOTE-BUSH.

Sepals deciduous. Petals unguiculate. Disk 10-lobed. Filaments winged below with a bifid scale on the inner side. Ovary 5-celled. Fruit globose, shortly stipitate, separating into 5 hairy one-seeded carpels. — Evergreen heavy-scented shrubs, with nodose branches, and yellow flowers.

1. **L. Mexicana**, Moric. Diffusely branched, 4 to 10 feet high, densely leafy, of a yellowish hue: leaves nearly sessile; the thick resinous leaflets inequilateral, with a broad attachment to the rachis: sepals silky: scales a little shorter than the filament, somewhat lacerate: fruit beaked by a slender style. — S. Colorado to California and Texas.

ORDER 18. GERANIACEÆ. (GERANIUM FAMILY.)

Leaves generally with stipules, either lobed or compound. Flowers on axillary peduncles, regular (in ours) and the parts in fives. Stamens mostly 10, often somewhat monadelphous. Ovary 5-celled, with a central axis.

Tribe I. Five glands of the receptacle alternate with the petals. Ovary deeply 5-lobed, the carpels separating elastically at maturity from the long-beaked and indurated central axis from below upward; the styles forming long tails which become revolute upwards or spirally twisted. — GERANIÆ.

1. **Geranium.** Fertile stamens 10. Tails of the carpels not bearded.

2. **Erodium.** Fertile stamens 5. Tails of the carpels bearded inside.

Tribe II. No glands alternate with the petals. Ovary not lobed, becoming in fruit a 5-celled loculicidal capsule. Leaves compound, with entire leaflets. Juice sour. — OXALIDÆ.

3. **Oxalis.** Leaves in ours 3-foliate.

1. GERANIUM, L. CRANESBILL.

Annual or perennial herbs, with enlarged joints, palmately lobed and mostly opposite leaves, scarious stipules, and 1 to 3-flowered peduncles.

* *Annual or biennial: flowers small.*

1. **G. Carolinianum**, L. Decumbent or ascending, diffusely branched, pubescent: leaves palmately 5 to 7-parted, the divisions cleft into oblong-linear lobes: petals rose-color, equalling the awned sepals: carpels hairy. — Across the continent.

Var. **longipes**, Watson. Peduncles usually solitary, and, with the pedicels, much elongated. — Bot. King's Exp. 50. Colorado and southward.

** *Perennial: flowers large.*

2. **G. Fremontii**, Torr. *Rather stout, more or less pubescent throughout, with a short, close, glandular pubescence, sparsely intermixed with longer, pilose hairs: upper leaves deeply 3 to 5-cleft; radical ones 7-cleft, segments 3-lobed or incised: petals light or deep purple.* — From Colorado to Wyoming and Idaho. Much that is called by this name is *G. cæspitosum*, James.

Var. **Parryi**, Engelm. Stems and peduncles plainly glandular-villose: leaves less deeply cut, ultimate lobes or teeth ovate, somewhat obtuse. — Gray's Peak, Colorado.

3. **G. Richardsoni**, Fisch. & Mey. *Taller but not so stout nor so hairy, with the pubescence usually fine and appressed, or somewhat glandular and spreading upon the pedicels: leaves 5 to 7-cleft nearly to the base, the broad lobes more or less incisely toothed: petals purple or sometimes white.* — In the mountains from New Mexico to British America and westward.

4. **G. incisum**, Nutt. *Closely resembling the last, but more villous and glandular-pubescent: leaves rather more narrowly and laciniately cut: petals usually deep purple.* — From California through Montana to the Saskatchewan.

5. **G. cæspitosum**, James. *More slender and more diffusely branched: radical leaves smaller, reniform, deeply 5 to 7-cleft, pubescent: flowers purple.* — New Mexico and northward. Includes many of the forms which have been called *G. Fremontii*.

2. ERODIUM, L'Her. STORESBILL.

Sterile stamens scale-like. Tails of the carpels becoming spirally twisted. — Leaves pinnate, peduncles umbellately 4 to 8-flowered, with a 4-bracted involucre; petals small.

1. **E. cicutarium**, L'Her. Hairy, much branched from the base: leaflets laciniately pinnatifid with narrow acute lobes: peduncles exceeding the leaves: petals bright rose-color: pedicels at length reflexed, the fruit still erect. — E. Utah and throughout the whole region west of the Rocky Mountains. Known as "Alfilaria," "Pin-clover," and "Pin-grass."

3. OXALIS, L. WOOD-SORREL.

Low, often acaulescent, with obcordate leaflets and peduncles umbellately or cymosely few to many-flowered.

1. **O. violacea**, L. Acaulescent, nearly smooth, leaves and scapes from a scaly bulb: scapes longer than the leaves, umbellately flowered: petals violet: capsule few-seeded. — Colorado, and common eastward.

2. **O. corniculata**, L. Caulescent, more or less villous, from running root-stocks: stems sometimes 2 or 3 feet high: petals yellow: capsule many-seeded.

Var. **stricta**, Sav. Without stipules. — *O. stricta*, L. Colorado and eastward across the continent.

ORDER 19. RUTACEÆ. (RUE FAMILY.)

Shrubs or small trees, with pellucid or glandular-dotted aromatic leaves, definite hypogynous stamens, and few seeds. — Sepals and petals 4 or 5, imbricated in the bud. Stamens as many or twice as many as the petals, inserted outside of a hypogynous disk. Stipules none.

1. **Ptelea**. Leaves 3-foliolate. Fruit orbicular, indehiscent, broadly winged. Stamens 4 or 5.

2. **Thamnosma**. Leaves simple, alternate. Fruit a 2-lobed coriaceous capsule. Stamens 8.

1. PTELEA, L. SHRUBBY TREFOIL. HOP-TREE.

Flowers polygamous. Ovary with a short thick stipe, 2-celled; cells 2-ovuled, the lower ovule abortive: style short. — Shrubs or small trees; flowers small, greenish-white, in terminal cymes or compound corymbs.

1. **P. angustifolia**, Benth. A shrub 5 to 25 feet high, with chestnut-colored punctate bark: leaflets oblong-lanceolate, entire, becoming smooth and shining with age: fruit emarginate at base and often above; the stipe narrow. — S. Colorado to California and Texas.

2. THAMNOSMA, Torr.

Disk cup-shaped, crenate or lobed. Ovary stipitate, 2-celled; cells 5 or 6-ovuled: style elongated. — Low glandular desert shrubs, strongly scented; leaves linear; flowers solitary.

1. **T. Texana**, Torr. Woody only at base, the slender stems 3 to 15 inches high: flowers on short naked pedicels: petals yellow tinged with purple. — *Rutosma Texanum*, Gray. S. W. Colorado and southward.

ORDER 20. **CELASTRACEÆ.** (STAFF-TREE FAMILY.)

Shrubs, with simple leaves, no stipules, and small dull-colored perfect regular flowers, the stamens as many as the petals and inserted on the margin of a broad disk which lines the calyx-tube. — Sepals and petals imbricated. Stamens alternate with the petals. Seeds arillate.

1. **PACHYSTIMA**, Raf.

Calyx with a short tube and 4 rounded lobes. Petals 4. Ovary free, 2-celled: style very short. Capsule small, coriaceous, 1 to 2-seeded. Seeds enclosed in a white many-cleft membranaceous aril. — Low evergreen shrubs; leaves smooth, opposite, very shortly petioled, serrate or serrulate; flowers green, in one to few-flowered axillary cymes.

1. **P. Myrsinites**, Raf. Leaves ovate to oblong or oblanceolate, cuneate at base: fruit smooth. — In the mountains from New Mexico to British America and westward to California. In dense clumps on wooded slopes. The only other species known (*P. Canbyi*) grows at a single station in the Alleghany Mountains of Virginia.

ORDER 21. **RHAMNACEÆ.** (BUCKTHORN FAMILY.)

Shrubs or small trees, with simple undivided leaves, small and often caducous stipules, and small regular flowers. — Sepals valvate in the bud; a conspicuous disk lining the short tube of the calyx. Petals clawed, mostly involute, each around a stamen in the bud, sometimes wanting. Stamens perigynous and alternate with the sepals. In ours the fruit is berry-like or dry, containing 2 to 4 separating seed-like nutlets, and the leaves are alternate.

1. **Rhamnus**. Calyx and disk free from the ovary; calyx-lobes erect or spreading. Petals small, short-clawed, or none. Filaments very short. Fruit berry-like, with 2 to 4 mostly indehiscent nutlets.
2. **Ceanothus**. Calyx and disk adnate to the base of the ovary; calyx-lobes connivent. Petals long-clawed, hooded. Filaments exserted. Fruit dry, with 3 dehiscent nutlets.

1. **RHAMNUS**, L. BUCKTHORN.

Flowers perfect or polygamo-dioecious. Calyx 4 to 5-cleft. Petals on the margin of the disk. — Leaves pinnately veined, with small deciduous stipules, and greenish flowers axillary cymose or racemose.

§ 1. *Seeds and nutlets deeply sulcate or concave on the back: flowers mostly dioecious, solitary or fascicled in the axils.* — **RHAMNUS** proper.

1. **R. alnifolia**, L'Her. A shrub 2 to 4 feet high: leaves deciduous, ovate-oblong, crenately serrate: petals wanting: fruit black, obovate, 3-lobed. — W. Wyoming, westward, and eastward across the continent.

§ 2 *Seeds and nutlets convex on the back: flowers mostly perfect, in pedunculate cymes.* — FRANGULA.

2. **R. Caroliniana**, Walter. Thornless shrub or small tree: *leaves oblong, obscurely serrulate, deciduous: flowers in one form umbelled, in another solitary in the axils: fruit globose, 3-seeded.* — *Frangula Caroliniana*, Gray. From the mountains eastward across the continent.

3. **R. Californica**, Esch. A spreading shrub, with the young branches somewhat tomentose: *leaves ovate-oblong to elliptical, denticulate or nearly entire, evergreen: peduncles with numerous mostly abortive flowers in subumbellate fascicles: fruit blackish purple with thin pulp, 2 to 3-lobed and 2 to 3-seeded.* — *Frangula Californica*, Gray. S. W. Colorado to California.

4. **R. Purshiana**, DC. Sometimes 20 feet high; young branches tomentose; *leaves elliptic, denticulate, deciduous, somewhat pubescent beneath: flowers rather large, in a somewhat umbellate cyme: fruit black, broadly obovoid, 3-lobed and 3-seeded.* — N. Idaho and westward in the Pacific States.

2. CEANOTHUS, L. NEW JERSEY TEA.

Flowers perfect. Calyx 5-cleft. — Shrubs or small trees, sometimes spinescent, with petioled leaves and showy thyrsoid or cymose white (in ours) flowers. — Watson, Proc. Am. Acad. x. 333. Ours all belong to the first section of the genus, in which the leaves are all alternate and 3-nerved, glandular-toothed or entire, and the fruit not crested.

* *Branches not spiny: inflorescence thyrsoid: leaves usually large, glandular-serrate.*

1. **C. velutinus**, Dougl. A shrub 2 to 3 feet high, usually glabrous: *leaves thick, broadly ovate or elliptical, resinous and shining above, sometimes velvety beneath: flowers in a loose thyse: peduncles usually short.* — Colorado, Utah, and northwestward.

Var. **lævigatus**, Torr. & Gray. *Leaves mostly glabrous beneath.* — More common than the type; ranging from Colorado northwestward to the British boundary.

2. **C. ovatus**, Desf. A shrub 2 to 3 feet high: *leaves narrowly oblong or elliptical-lanceolate, glandular-serrulate, nearly glabrous: thyse umbel-like, the pedicels elongated and closely approximated.* — Includes *C. oralis*, Bigel. Colorado and Wyoming.

3. **C. sanguineus**, Pursh. A shrub 4 to 12 feet high: *stem and branches reddish: leaves broadly ovate or obovate, subcordate, serrate: thyrsoid corymbs in lateral panicles, on very short peduncles.* — Includes *C. Oreganus*, Nutt. Along the Missouri and its tributaries.

* * *Branches mostly spinose, grayish: flowers in simple clusters: leaves small, entire.*

4. **C. Fendleri**, Gray. A shrub one or two feet high, widely and intricately branched: *leaves oval or elliptic, silky-canescens beneath, smoothish and green above: flowers in clusters, dense, sessile, glabrous.* — Colorado and southward.

ORDER 22. **VITACEÆ.** (VINE FAMILY.)

Woody plants, mostly climbing by tendrils, branchlets articulated and often thickened at the nodes, usually palmately veined or lobed or compound alternate leaves, paniced cymose or thyrsoïd inflorescence, small greenish or whitish flowers, and fruit a berry. — Flowers very commonly polygamous or diœcious. Calyx minute, truncate, or 4 to 5-toothed, caducous or early deciduous. Petals 4 or 5, valvate. Stamens the same number and opposite. Ovules in pairs or solitary in the cells of the ovary.

1. **Vitis.** Calyx filled with an adnate fleshy disk which bears the petals and stamens. Leaves simple.
2. **Ampelopsis.** Disk none. Leaves palmately compound.

1. **VITIS**, Tourn. GRAPE.

Petals thick and caducous. Stamens distinct. Ovary 2-celled, with a pair of ovules in each cell. — Tendrils and flower-clusters opposite the leaves, the former almost always at least once forked.

1. **V. riparia**, Michx. Leaves usually incisely 3-lobed, the lobes long-pointed: panicles small, rather simple: berries mostly with bloom: seeds obtuse or somewhat obcordate and with an inconspicuous rhaphe. — *V. cordifolia*, var. *riparia*, Gray. Colorado; common in the Atlantic States.

2. **AMPELOPSIS**, Michx. VIRGINIA CREEPER.

Calyx slightly 5-toothed. Petals concave, thick, expanding before the fall. — Leaves with 5 oblong-lanceolate sparingly serrate leaflets. Tendrils fixing themselves to trunks or walls by dilated sucker-like disks at their tips.

1. **A. quinquefolia**, Michx. A woody vine in low rich grounds, climbing extensively, sometimes by rootlets as well as by its disk-bearing tendrils: berries small and blackish. — Colorado (*Meehan*), and throughout the Atlantic and Mississippi Valley States. Leaves turning bright crimson in autumn.

ORDER 23. **SAPINDACEÆ.** (SOAPBERRY FAMILY.)

Ours are all trees of the MAPLE FAMILY, which has compound or lobed apposite leaves without stipules, polygamous or diœcious regular flowers, sometimes without petals, each cell of the 2-celled fruit producing a wing and becoming a samara.

1. **Acer.** Leaves palmately lobed or rarely divided. Flowers polygamous.
2. **Negundo.** Leaves pinnate. Flowers diœcious, apetalous.

1. **ACER**, Tourn. MAPLE.

Calyx colored, usually 5-lobed. Petals as many or none. Stamens 3 to 12, usually 8, inserted with the petals upon a lobed disk. Fruit divaricately 2-winged above, separable at maturity, each 1-seeded. — Flowers in umbel-like corymbs or fascicles.

1. **A. grandidentatum**, Nutt. *Leaves cordate or truncate at base, rather deeply 3-lobed, with broad round sinuses; lobes rather acute, coarsely sinuate-dentate: the umbel-like corymb nearly sessile, few-flowered, the pedicels long and nodding.* — Utah and northward along the western slopes of the mountains. Rarely attains a foot in diameter and 30 to 40 feet in height.

2. **A. glabrum**, Torr. *Shrub 6 to 10 feet high: leaves subreniform, orbicular in outline, 3-lobed or more usually 3-parted; segments short and broad, acutely incised and toothed, somewhat 3-lobed, middle one cuneate: the umbel-like corymb pedunculate: sepals about 8.* — Includes *A. tripartitum*, Nutt. From New Mexico to Wyoming and westward. Along water-courses among the mountains.

2. **NEGUNDO**, Mœnch. BOX-ELDER.

Petals and disk none. Fruit as in *Acer*. — Sterile flowers on clustered capillary pedicels, the fertile in drooping racemes.

1. **N. aceroides**, Mœnch. Leaflets very veiny, ovate, pointed, toothed: fruit smooth, with large rather incurved wings. — In the valleys from New Mexico northward. A tree with light green twigs and delicate drooping clusters of greenish flowers a little earlier than the leaves.

ORDER 24. **ANACARDIACEÆ**. (CASHEW FAMILY.)

Shrubs or trees with a resinous juice, alternate leaves without stipules, and small regular flowers commonly polygamous or diœcious. Stamens as many or twice as many as the petals. The free ovary 1-celled and 1-ovuled, but the styles often 3. Fruit a dry drupe.

1. **RHUS**, L. SUMACH.

Sepals and petals usually 5. Stamens inserted under the edge of a disk lining the base of the calyx. — Leaves simple or pinnate.

* *Leaflets 11 to 31: flowers in a terminal thyrsoïd panicle.*

1. **R. glabra**, L. Shrub 2 to 12 feet high: leaflets whitened beneath, lanceolate-oblong, pointed, serrate: fruit globular, clothed with acid crimson hairs; the stone smooth. — Colorado, Utah, Idaho, and eastward across the continent. Not poisonous.

* * *Leaflets 3.*

2. **R. Toxicodendron**, L. *Climbing by rootlets over rocks or ascending trees: leaflets rhombic-ovate, rather downy beneath, variously notched, sinuate, or cut-lobed: flowers in loose and slender axillary panicles: fruit globular, glabrous, whitish or dun-colored; the stone striate.* — Colorado, Utah, Wyoming, and eastward. Poisonous to the touch.

3. **R. aromatica**, Ait., var. **trilobata**, Gray. A shrub 2 to 5 feet high, diffusely branched, strongly scented: leaflets cuneate-obovate or rhomboidal, coarsely toothed above and often 3-lobed: flowers in clustered scaly bracted spikes like catkins, preceding the leaves, yellowish: fruit flattish, somewhat viscid. — *R. trilobata*, Nutt. Common throughout the Rocky Mountains to the Upper Missouri, and westward.

ORDER 25. LEGUMINOSÆ. (PULSE FAMILY.)

Plants with irregular or sometimes regular flowers, mostly 10 monadelphous or diadelphous stamens, and a single simple free pistil becoming a legume in fruit. — Leaves alternate, with stipules, usually compound.

SUBORDER I. PAPILIONACEÆ.

Flower irregular. Calyx mostly 5-cleft or 5-toothed. Corolla of 5 petals (rarely fewer); one (standard) superior, larger and always external, covering in the bud the two lateral ones (wings), and these covering the inferior pair, which together form the keel, this in turn enclosing the stamens and pistil. Style generally inflexed or incurved.

* Stamens distinct.

+ Leaves digitately 3-foliolate.

1. **Thermopsis**. Stipules conspicuous, and yellow flowers in racemes.

+ + Leaves unequally pinnate.

2. **Sophora**. Pod thick, large, several-seeded, often transversely constricted. Leaves coriaceous.

3. **Amorpha**. Pod small, 1 to 2-seeded. Petal one. Stamens monadelphous at the very base.

* * Stamens monadelphous or diadelphous (9 and 1).

+ Anthers of two forms: filaments strictly monadelphous: leaves digitate, of more than 3 entire leaflets.

2. **Lupinus**. Calyx 2-lipped. Standard with recurved sides: keel falcate. Pod large, straight.

+ + Anthers reniform.

+ + Leaflets 3 (rarely 5 to 7), denticulate or serrulate: stamens diadelphous or nearly so: pods small and enclosed in the calyx.¹

4. **Trifolium**. Flowers capitate. Corolla persistent, united with the filaments.

+ + Leaves unequally pinnate (very rarely digitate or simple); leaflets entire: no tendril.
= Flowers in axillary umbels or solitary: stamens diadelphous.

5. **Hosackia**. Corolla yellow or partly white or turning reddish: claw of the standard usually remote from the others. Pod linear, several-seeded.

= = Flowers in spikes, racemes, or heads, never umbellate.

a. Herbage glandular-dotted: stamens mostly monadelphous: pod usually indehiscent.

6. **Psoralea**. Herbs, with 3 to 7-foliolate leaves and axillary spikes or racemes. Pod one-ovuled, one-seeded.

¹ *Medicago* is an introduced genus, with small flowers in axillary racemes or spikes, petals free and deciduous, and the pod spirally coiled or curved. See foot-note, p. 54.

7. **Dalea.** Shrubby or herbaceous, with pinnate or palmate leaves and terminal spikes or heads. Wings and keel inserted on and articulated with the stamen tube. Pod 2 to 6-ovuled, mostly one-seeded.
8. **Petalostemon.** Herbs, with odd-pinnate leaves and terminal spikes or heads. Stamens 5; the cleft tube of filaments bearing 4 of the petals on its summit. Pod 1 to 2-seeded.
9. **Amorpha.** Shrubs, with pinnate leaves and terminal racemes or spikes. Wings and keel of the corolla wanting. Stamens monadelphous only at base, otherwise distinct. Pod 1 to 2-ovuled, 1 to 2-seeded.
- b. Shrubs or shrubby: herbage not glandular: leaves pinnate: pod flat, 2-valved: stamens diadelphous.
10. **Peteria.** Racemes terminal or opposite the leaves. Pod narrow, many-seeded. Leaflets not stipellate.
11. **Robinia.** Pod thin, margined on one edge. Leaflets stipellate.
- c. Herbage glandular or glutinous and more or less punctate: leaves unequally pinnate: stamens diadelphous; anthers confluent one-celled.
12. **Glycyrrhiza.** Flowers, etc. of *Astragalus*. Pod prickly or muricate, short, one-celled.
- d. Herbage neither glandular nor dotted: stamens diadelphous; anthers 2-celled: leaves pinnate.
13. **Astragalus.** Pods mostly bladdery or turgid, or more or less 2-celled by infusion of the dorsal suture. Keel not tipped with a point or sharp appendage.
14. **Oxytropis.** Keel tipped with a point; otherwise as in *Astragalus*.
- ++ ++ ++ Herbs with odd-pinnate leaves and no tendril: pod transversely 2 to several-jointed, the reticulated one-seeded joints indehiscent.
15. **Hedysarum.** Stamens diadelphous (5 and 1).
- ++ ++ ++ ++ Leaves abruptly pinnate, terminated by a tendril or bristle: stamens diadelphous: peduncles axillary: pod 2-valved.
16. **Vicia.** Stamen-tube oblique at the summit. Style filiform, hairy around and below the apex.
17. **Lathyrus.** Stamen-tube nearly truncate. Style dorsally flattened toward the apex, hairy on the inner side, usually twisted half round.

SUBORDER II. CÆSALPINIÆ.

Flower more or less irregular. Perigynous disk lining the tube or base of the calyx. Petals imbricated in the bud, the one corresponding to the standard within the lateral ones. Stamens 10 or fewer, distinct. — In ours the corolla is yellow and not at all papilionaceous.

18. **Cassia.** Leaves simply and abruptly pinnate. Anthers either 10 and unequal, or some of the upper ones imperfect, abortive, or wanting.
19. **Hoffmanseggia.** Leaves abruptly or unequally bipinnate, and dotted with black glands. Stamens 10, with anthers all perfect and filaments hairy. Racemes opposite the leaves.

SUBORDER III. MIMOSÆ.

Flowers regular, small, and numerous in spikes or heads. No disk. Calyx and corolla valvate in the bud. Stamens as many or twice as many as the petals, hypogynous. Leaves usually twice pinnate.

20. **Schrankia.** Petals united below into a cup. Pod covered with small prickles or rough projections.

1. THERMOPSIS, R. Br.

Calyx campanulate, cleft to the middle. Standard shorter than the oblong wings, the sides reflexed: keel nearly straight, equalling the wings. Pod linear to oblong-linear, much compressed, shortly stipitate or nearly sessile, straight or incurved. — Stout perennial herbs with erect clustered stems; stipules free, leaflets entire.

1. **T. rhombifolia**, Richardson. Stems angular, nearly smooth: *stipules as long as the petioles*; leaflets *obovate-cuneiform, silky-puberulent*, at length nearly glabrous: bracts oval: *pod alcate, recurved or pendulous, glabrous*, 10 to 14-seeded. — From Colorado northward, at the head-waters of the Platte, Missouri, and Saskatchewan.

2. **T. montana**, Nutt. Somewhat silky-pubescent, at length glabrous: *stipules exceeding the petioles*; leaflets *oblong-obovate to oblong, sparingly villous beneath, smooth above*: bracts mostly lanceolate: *pod straight, erect, pubescent*, 10 to 12-seeded. — Torr. & Gray, Fl. i. 388. *T. fabacea* of Hayd. Rep. 1872. *T. fabacea*, var. *montana*, of Bot. King's Exp., Hayd. Rep. 1870 and 1871, and Fl. Colorado. From New Mexico to Washington and eastward to the borders of Nebraska and the Dakotas.

2. SOPHORA, L.

Calyx-tube campanulate; teeth short. Petals nearly equal; standard broad. Pod stipitate, terete or somewhat compressed. — Ours are herbs; leaves with numerous entire leaflets; stipules small or obsolete; flowers white, in terminal racemes.

1. **S. sericea**, Nutt. Low, 6 to 12 inches high, more or less silky-canescens: leaflets about 21, elliptic or cuneate-oval: racemes short, at first scarce exerted beyond the leaves: calyx gibbous at base. — High plains of Colorado and northward along the plains of the Platte and the Missouri.

3. LUPINUS, L. LUPINE.

Wings united above, enclosing the keel. Stigma bearded. Pod 2-valved, compressed, coriaceous. — Generally herbaceous; stipules adnate to the petioles. Flowers in terminal racemes, verticillate, or scattered, bracteate.

§ 1. *Ovules several: cotyledons petioled in germination.* — LUPINUS proper.

Ours are all herbaceous perennials, with oblong pods.

* *Dwarf and caespitose: racemes usually short and dense: pods 3 to 4-seeded.*

1. **L. caespitosus**, Nutt. Nearly stemless, silky-hirsute: *raceme sessile, shorter than the leaves*; bracts setaceous, deciduous: petals pale blue. — Torr. & Gray, Fl. i. 379. From the mountains of W. Colorado and Utah northward to the head-waters of Snake and Yellowstone Rivers.

2. **L. aridus**, Dougl. Pubescence villous, both loose and appressed: leaflets oblanceolate: *peduncles shorter than the leaves: bracts nearly equalling the calyx*: petals purple; the standard elliptical. — Sources of the Missouri, to Washington, Oregon, and California. In low valleys.

3. **L. minimus**, Dougl. Appressed silky-villous: leaflets obovate or oblanceolate: *peduncles equalling or exceeding the leaves*; bracts linear: petals

purple; the standard orbicular. — From N. W. Wyoming to Washington and California.

4. **L. Lyallii**, Gray. *Stems from a spreading woody caudex: pubescence dense, villous, appressed: leaflets obovate: racemes very short, the peduncles much exceeding the leaves: bracts short: petals purple; the standard elliptical.* — Proc. Am. Acad. vi. 334. Bitter Root Mountains, and in the Cascades of Washington.

* * *Stems taller, erect or ascending, and racemes elongated.*

+ *Flowers large: leaflets 7 to 10, glabrous above or nearly so: ovules 5 to 8.*

5. **L. Burkei**, Watson. *Stout, erect, the short and silky pubescence closely appressed: lower leaves long-petioled; leaflets about equalling the petioles: raceme usually short and dense; bracts villous: flowers purple or sometimes white: calyx with spreading pubescence: keel nearly semicircular: pod 8-seeded.* — Proc. Am. Acad. viii. 525. *L. polyphyllus*, of Bot. King's Exp. and Hayd. Rep. 1871 and 1872. Head-waters of Yellowstone and Snake Rivers, to N. Nevada.

6. **L. Sitgreavesii**, Watson. *Puberulent and somewhat silky villous with spreading hairs: raceme open, shortly peduncled: calyx appressed-silky: standard rounded, naked: ovules 5.* — Proc. Am. Acad. viii. 527. In the mountains from the S. Sierra Nevada to S. Colorado and New Mexico.

7. **L. Plattensis**, Watson. *Appressed silky-villous throughout, with a somewhat glaucous hue: leaflets spatulate: raceme loose, shortly peduncled: petals pale blue, with a conspicuous darker spot upon the standard.* — Proc. Am. Acad. xvii. 369. *L. ornatus*, Dougl., var. *glabratus*, Watson. The *L. ornatus* of the Hayden Reports. Common on the Upper Platte and northward.

+ + *Flowers smaller (3 to 5 lines long): ovules 2 to 6.*

+ + *Lower petioles elongated: leaflets not glabrous above: racemes mostly dense.*

8. **L. leucophyllus**, Dougl. *Leafy, densely silky-tomentose throughout and somewhat villous: leaflets 7 to 10, oblanceolate or cuneate-oblong; the upper petioles about equalling the leaves: racemes sessile or nearly so, densely flowered: pedicels stout: petals blue or pink; the standard densely villous.* — Head-waters of the Platte and Missouri Rivers, to Washington and N. California.

+ + + *Stems slender: pubescence short, silky, appressed: petioles and peduncles mostly short: flowers subverticillate or scattered, on short slender pedicels.*

9. **L. parviflorus**, Nutt. *Stems 2 or 3 feet high: pubescence scanty, the calyx and pedicels silky: leaflets 5 to 11, oblanceolate to obovate, glabrous above, the lower leaves shorter than the petioles: standard naked.* — Mountains of Central Colorado, to the sources of Snake River, and westward to Central California and the Columbia River.

10. **L. laxiflorus**, Dougl. *Stems 1 to 2 feet high: leaflets 6 to 8, narrowly oblanceolate, silky on both sides, at least half as long as the petioles: calyx narrowed and saccate at base: standard somewhat pubescent.* — Wasatch Mountains, westward to N. California and Vancouver Island.

11. **L. argenteus**, Pursh. *Hoary with thick pubescence: stem 1 to 2 feet high: leaflets 5 to 8, linear-lanceolate, smooth above or nearly so, about equalling the petioles: calyx gibbous but not spurred at base: petals blue or cream-*

colored; standard very broad.—From Central Colorado to Montana, and westward along the plains of Snake and Columbia Rivers.

Var. **decumbens**, Watson. Stem stouter and more leafy: raceme dense.—Proc. Am. Acad. viii. 532. *L. decumbens*, Torr. *L. laxiflorus*, of Hayd. Rep. 1872. *L. laxiflorus*, var. *tenellus*, of Hayd. Rep. 1871. From Montana and Wyoming southward into New Mexico and Arizona.

Var. **argophyllus**, Watson. More silky-pubescent; the leaflets *nearly equally so on both sides, longer than the petioles*: flowers larger: *calyx decidedly spurred*.—Proc. Am. Acad. viii. 532. S. Colorado and New Mexico.

§ 2. *Ovules 2 (rarely 3 or 4): cotyledons broad and clasping after germination, usually long persistent. Erect annuals: leaflets cuneate-oblong or -obovate: bracts persistent: pod ovate*.—**PLATYCARPOS**, Watson.

12. **L. pusillus**, Pursh. Rather stout, 3 to 10 inches high, *hirsute with long spreading hairs*: leaflets mostly 5, nearly smooth above, about half as long as the petioles: *racemes spicate, nearly sessile, 2 or 3 inches long*: petals purple or rose-color: pod very hirsute.—From the Upper Missouri to the Columbia and southward east of the Sierras, to Arizona and New Mexico.

13. **L. Kingii**, Watson. Resembles the last, but more slender and *villous with soft white hairs*: *racemes very short, few-flowered, on long slender peduncles*: pods and seeds smaller.—Proc. Am. Acad. viii. 534. *L. Sileri*, Watson. Utah, Colorado, and southward along the Rio Grande.

4. **TRIFOLIUM**,¹ L. CLOVER.

Herbs with palmately compound leaves, stipules adnate to the petiole, flowers in capitate racemes, spikes, or umbels, peduncles axillary or only apparently terminal.—Watson Rev. Proc. Am. Acad. xi. 127.

* *Leaflets 5 to 7: heads not involucrate, terminal and axillary: flowers sessile: calyx-teeth filiform, plumose: low or dwarf perennials.*

1. **T. megacephalum**, Nutt. Stout, somewhat villous: leaflets cuneate-oblong to obovate, obtuse, toothed: flowers very large (1 inch long), purplish, in spicate heads: calyx half as long, the teeth very much longer than the tube: pod stipitate, smooth.—Torr. & Gray, Fl. i. 315. Head-waters of the Missouri, to Washington and N. E. California.

* * *Leaflets 3: heads not involucrate, terminal: flowers sessile or nearly so: perennial or biennial.*

+ *Cauliscent, often tall: calyx-teeth very narrow, shorter than the corolla.*²

2. **T. eriocephalum**, Nutt. *Villous with spreading hairs*, or the stem and leaves rarely glabrous: leaflets narrowly oblong or sometimes broader,

¹ *Medicago sativa*, L., has leaves pinnately 3-foliolate, the leaflets obovate-oblong, and purple flowers.—Known as "Lucerne," and introduced into Wyoming, Utah, and westward.

² *T. pratense*, L., the common Red Clover, is becoming introduced and may be known by its oval or obovate leaflets often notched at the end and marked above with a pale spot, broad bristle-pointed stipules, ovate sessile heads of rose-purple flowers, and scarcely hairy calyx.

T. repens, L., the White Clover, is also introduced, and may be known by its creeping stems, axillary peduncles, inversely heart-shaped or merely notched leaflets, narrow stipules, long petioles and peduncles, the short pedicels reflexed when old, and the white flowers turning brownish in fading.

serrulate: flowers in dense ovate spikes, at length reflexed, ochroleucous: calyx-teeth very villous, lax, nearly equalling the petals: ovary hairy. — Torr. & Gray, Fl. i. 313. S. W. Colorado, N. California, Oregon and Idaho.

3. **T. longipes**, Nutt. Slender: stem usually glabrous, the leaflets and calyx sparingly villous: leaflets narrowly oblong to linear, serrulate: heads ovate, looser than in the last, not reflexed: flowers ochroleucous or tinged with purple: calyx-teeth straight, more or less hairy, shorter than the corolla. — Torr. & Gray, Fl. i. 314. From N. Arizona and Colorado to the British boundary, and west to the Pacific.

Var. (?) **latifolium**, Hooker. Often low: leaflets broader: flowers pedicellate in loose heads. — With the species.

4. **T. Kingii**, Watson. Glabrous throughout: leaflets oblong to oblanceolate, very acute, sharply denticulate: peduncles exceeding the leaves: heads naked, the purplish flowers at length reflexed; the rachis often produced above the head, with a few spinescent bracts: calyx-teeth about one third the length of the corolla. — Bot. King's Exp. 59. *T. Haydeni*, Porter in Hayd. Rep. 1871. From Montana through Idaho and Utah to N. E. California.

+ + Dwarf, caespitose, acaulescent or nearly so.

++ Glabrous: flowers large: ovary smooth, linear, 4 to 7-ovuled.

5. **T. nanum**, Torr. Leaflets small, oblanceolate, serrulate, strongly veined: peduncles very short, radical: flowers 1 to 3, dark purple: calyx-teeth broad, acute, shorter than the tube: ovary 4 to 5-ovuled. — Mountains of Colorado and Utah.

6. **T. Brandegei**, Watson. Leaflets elliptic-oblong, thin, entire: peduncles about equalling the leaves: flowers spicate in a loose naked head, purplish: calyx-teeth lanceolate, acuminate, a little longer than the tube: ovary stipitate, 7-ovuled. — Proc. Am. Acad, xi. 130. S. W. Colorado and N. W. New Mexico.

++ ++ Pubescent: flowers small: ovary obovate, densely villous, 2-ovuled, at length exerted from the calyx.

7. **T. gymnocarpon**, Nutt. Leaflets ovate-oblong to oblanceolate, serrate: peduncles shorter than the leaves: flowers 2 to 6, in rather close heads, on short pedicels: calyx-teeth equalling the tube. — Torr. & Gray, Fl. i. 320. Bot. King's Exp. 62, t. 8. W. Wyoming and the Wasatch.

* * * Leaflets 3: heads subtended by a mostly monophyllous usually many-cleft involucre, axillary: flowers in whorls, sessile or nearly so, not reflexed.

+ Low or dwarf perennials, acaulescent or nearly so: flowers rather large: involucre parted, somewhat scarious.

8. **T. Parryi**, Gray. Glabrous, often stout: leaflets oblong to oblanceolate, sharply dentate: bracts 5 to 7, oblong, obtuse: flowers 20 or more in a head: calyx-teeth broadly subulate, equalling the tube: corolla rose-purple. — Am. Jour. Sci. II. xxxiii. 409. — Mountains of Colorado, Utah, and Wyoming.

9. **T. dasphyllum**, Torr. & Gray. Caespitose: leaves, peduncles, and calyx more or less silky: leaflets linear-lanceolate, entire: head globose, on a long radical peduncle: bracts very small, unequal, lanceolate: calyx-teeth linear, much longer than the tube. — Mountains of Colorado, and the Uintas.

10. **T. andinum**, Nutt. Caespitose, silky-canescens: leaflets rigid, cuneate-oblong, entire, strongly veined: peduncles radical, about equalling the leaves:

heads hemispherical: involucre of 2 broadly stipuled 3-foliolate leaves: ovary one-ovuled. — Watson, Bot. King's Exp. 60, t. 8. W. Wyoming and N. E. Utah.

+ + *Slender annuals, glabrous: lobes of the involucre laciniately and sharply toothed.*

11. **T. involucratum**, Willd. Branching from the base: leaflets mostly oblanceolate, acute at each end, spinulosely-serrulate: flowers in close heads, purple tipped with white: calyx-teeth thin: ovules several. — From Mexico to the British boundary, and from Colorado and New Mexico to the Pacific.

12. **T. pauciflorum**, Nutt. Very slender: stems ascending or decumbent: leaflets obovate or oblanceolate or sometimes linear, usually obtuse or retuse, serrulate: heads rather few-flowered: involucre small: flowers little exceeding the calyx, deep purple or light rose-colored: calyx-teeth rigid, setosely acuminate: ovules two. — *T. variegatum*, Nutt., in Bot. King's Exp. and Hayd. Rep. 1872. From Washington and Montana to S. California and Utah.

5. HOSACKIA, Douglas.

Calyx-teeth nearly equal, usually shorter than the tube. Petals free from the stamens, nearly equal; keel somewhat incurved. Pod sessile, partitioned between the seeds. — Herbaceous: leaves (in ours) 1 to 5-foliolate; stipules minute and gland-like. — Watson in Bot. King's Exp. 432.

1. **H. Wrightii**, Gray. Perennial: ashy-puberulent, bushy-branched, very leafy: leaflets 3 to 5, apparently palmate and sessile, the lowest oblong, the rest filiform-linear: peduncles short, rarely equalling the leaf, 1 to 2-flowered: calyx-teeth setaceous-subulate, about equalling the tube: keel not falcately-attenuate, mostly very obtuse. — S. W. Colorado, New Mexico, and Arizona.

2. **H. Purshiana**, Benth. Annual: more or less silky-trilous or sometimes glabrous: leaves nearly sessile; leaflets 3 (or 1, rarely 4), varying from ovate to lanceolate: peduncles exceeding the leaves, one-flowered: calyx-teeth linear, much longer than the tube, about equalling the corolla: keel attenuated upward, falcate, mostly acute. — From Washington to Northern Mexico, eastward to the Upper Missouri, Arkansas, and N. Carolina.

6. PSORALEA, L.

Two upper calyx-lobes often connate. Keel united with the wings. Stamens mostly diadelphous. Pod sessile, thick and often wrinkled. — Perennial herbs: leaves (in ours) digitate, the leaflets entire; stipules not adnate to the petiole: flowers white or purplish.

* *Flowers in panicked racemes.*

1. **P. tenuiflora**, Pursh. Slender, much branched and bushy, minutely hoary-pubescent when young: leaflets varying from linear to obovate-oblong: lobes of the calyx and bracts ovate, acute: pod glandular. — *P. floribunda*, Nutt. From Texas to Arizona, northward to the Missouri River and eastward into Illinois.

* * *Flowers in interrupted spikes: peduncles and lower tooth of the calyx elongated.*

2. **P. argophylla**, Pursh. *Silvery silky-white all over, divergently branched: leaflets elliptical-lanceolate: lobes of the calyx and bracts lanceolate.* — From N. Wisconsin to the Saskatchewan and Upper Missouri, and in Colorado.

3. **P. campestris**, Nutt. *Like the last but much less hirsute and silvery, with short white appressed hairs, and more branching: stipules linear; leaflets linear or oblong-linear, rather obtuse, nearly glabrous above: bracts 3-flowered, broadly ovate.* — Plains of the Platte.

4. **P. digitata**, Nutt. *Canescent, diffusely branched: stipules lanceolate, reflexed; leaflets cuneate-oblong and oblong-linear with an abrupt rigid point, smooth and minutely dotted above, hirsute beneath: bracts obcordate or reniform: lobes of the calyx ovate: pod hirsute, not wrinkled.* — S. E. Colorado and southeastward along the Red River into Arkansas.

* * * *Flowers in capitate or oblong dense spikes.*

+ Root tuberous.

5. **P. esculenta**, Pursh. *Roughish-hairy all over: stem stout: leaflets obovate or lanceolate-oblong: spikes oblong, long-peduncled: lobes of the calyx and bracts lanceolate.* — High plains from the Saskatchewan to Louisiana and Texas.

6. **P. hypogæa**, Nutt. *Acaulescent: hirsute with whitish appressed hairs: leaflets linear-lanceolate or linear-oblong, nearly glabrous above: spikes capitate, on peduncles much shorter than the petioles: lobes of the calyx linear, acuminate, the lowest lanceolate, elongated.* — Sandy plains of N. Colorado (Greene), and along the Platte.

+ + Root not tuberous.

7. **P. lanceolata**, Pursh. *Glabrous, or with a few scattered hairs: stipules linear-lanceolate; leaflets linear to oblong-obovate, acute: peduncles about equaling the leaves: calyx very small, its teeth short, obtuse, nearly equal: ovary very silky: pod very glandular.* — Washington to N. Arizona and eastward to the Saskatchewan and Nebraska.

8. **P. cuspidata**, Pursh. *Canescent with appressed pubescence: stipules subulate; leaflets obovate or elliptical-oblong, pubescent: peduncles much longer than the leaves: calyx large, somewhat inflated, gibbous at the base, conspicuously dotted, teeth triangular-lanceolate, acuminate, the lower one produced: pod hid in the large calyx.* — From S. E. Colorado to Texas and Arkansas.

7. DALEA, L.

Calyx (in ours) deeply cleft, with plumose teeth. Standard cordate, its claw free. Pod ovate, compressed, included in the calyx. — Leaflets small, entire, sometimes stipellate.

* *Glabrous: flowers not yellow: leaflets 4 to 20 pairs, dotted.*

1. **D. alopecuroides**, Willd. *Erect annual, 1 to 2 feet high: leaflets 10 to 20 pairs, linear-oblong: flowers light rose-color, in cylindrical spikes: bracts*

conspicuous, ovate, pubescent, deciduous: calyx very villous, with long slender teeth. — From Colorado to S. Arizona and eastward to the Mississippi from Texas to Illinois.

2. **D. laxiflora**, Pursh. Erect, 3 to 4 feet high: branches slender and spreading: leaflets 4 to 5 pairs, linear-oblong: spikes panicled, few-flowered: flowers distant, white: bracts very broad, almost orbicular, glandular, coriaceous, glabrous, slightly cuspidate: calyx-teeth beautifully plumose. — From Colorado to the plains of the Missouri, and southeastward to Arkansas and Texas.

3. **D. formosa**, Torr. Suffrutescent, much branched: leaflets very small, about 5 pairs, cuneate-oblong, retuse, dotted with black glands beneath: spikes loose, few-flowered, on short peduncles: flowers large and showy, bright purple: bracts ovate, silky-villous on the margin. — On the Platte (James), and southward.

* * Not glabrous: flowers yellow (deep purple in No. 7).

+ Leaves palmately trifoliolate, not dotted.

4. **D. Jamesii**, Torr. & Gray. Stems several from one root, 4 to 9 inches high, somewhat woody at base: whole plant silky-pubescent: leaflets obovate, very obtuse: spikes oblong, sessile, dense and broad; bracts ovate, acuminate, villous. — S. Colorado and southeastward.

+ + Leaves pinnately compound, with 2 to 6 pairs of leaflets.

5. **D. aurea**, Nutt. Stem pubescent, erect, 2 feet high: leaflets 3 to 4 pairs, oblong-obovate and linear-oblong, more or less silky-pubescent: spikes ovate, very compact, on long peduncles: bracts rhombic-ovate, as long as the calyx. — On the plains from the Missouri River to Texas.

6. **D. rubescens**, Watson. Like the last but more slender, the leaves trifoliolate, and the flowers smaller, the yellow petals becoming purplish. — Proc. Am. Acad. xvii. 369. **D. nana**, Torr., var. *elatio*r, Gray. S. E. Colorado, southward and eastward.

7. **D. lanata**, Spreng. Decumbent, canescently tomentose throughout: the stems 1 to 3 feet long: leaflets 4 to 6 pairs, obovate-cuneate, emarginate: spikes usually opposite the leaves. — From Nebraska, Arkansas, and Indian Territory to Texas, New Mexico, S. Colorado, and Utah.

8. PETALOSTEMON, Michx. PRAIRIE CLOVER.

Similar to the last, but with only 5 stamens and the flowers always in dense bracteate cylindrical spikes.

* Smooth or nearly so: leaflets 5 to 9: spikes globose to cylindrical.

1. **P. violaceus**, Michx. Leaflets 5, narrowly linear: spikes globose-ovate, or oblong-cylindrical when old: bracts pointed, not longer than the silky-hairy calyx: corolla rose-purple. — Prairies from the Saskatchewan to Texas, and from Colorado to Indiana.

2. **P. candidus**, Michx. Leaflets 7 to 9, lanceolate or linear-oblong: spikes oblong, cylindrical when old: bracts awned, longer than the nearly glabrous calyx: corolla white. — With the last.

3. **P. macrostachyus**, Torr. Leaflets 5 to 7, lanceolate-oblong, obtuse, dotted beneath: spikes cylindrical, elongated: bracts as long as the flower: calyx silky-villous: corolla nearly white. — From Colorado to Oregon.

* * *Soft downy or silky-villous all over: leaflets 13 to 17: spikes cylindrical.*

4. **P. villosus**, Nutt. Leaflets linear or oblong: spikes 1 to 5 inches long, short-peduncled: corolla rose-color. — Along the Upper Missouri and Mississippi to N. Wisconsin.

9. AMORPHA, L. FALSE INDIGO. LEAD PLANT.

Standard erect, folded together. — The flowers purple or violet, small, in dense clustered terminal spikes.

* *Pods 1-seeded: leaflets small, crowded.*

1. **A. canescens**, Nutt. *Whitened with hoary down, 1 to 3 feet high:* leaflets 15 to 25 pairs, elliptical, smoothish above with age. — From British America to Texas and from Colorado to Indiana.

2. **A. microphylla**, Pursh. *Very low, nearly glabrous:* leaflets somewhat ovate-elliptical, rigid: spikes solitary and aggregated. — Along the Platte to the mountains and northward to the plains of the Red River.

* * *Pods 2-seeded: leaflets scattered.*

3. **A. fruticosa**, L. Rather pubescent or smoothish: leaflets 8 to 12 pairs, oval. — Along rivers from Colorado northeastward to British America and eastward to Pennsylvania and Florida.

10. PETERIA, Gray.

Calyx tubular at base, gibbous above. Standard open at the apex, with reflexed sides, narrowed into a long claw. Ovary stipitate.

1. **P. scoparia**, Gray. Rigid, branching, glabrous: leaflets numerous, very small, entire; stipules small, subulate: flowers scattered, yellowish. — Pl. Wright. i. 50. S. W. Colorado and southward.

11. ROBINIA, L. LOCUST.

Calyx slightly 2-lipped. Standard large and rounded, turned back. — Trees or shrubs, often with prickly spines for stipules: flowers showy, in hanging axillary racemes. Base of the leaf-stalks covering the buds of the next year.

1. **R. Neo-Mexicana**, Gray. Shrub 4 to 6 feet high: stipular prickles subrecurved, sharp and stout: leaflets elliptical or oblong: peduncles and the short crowded racemes hispid with straight glanduliferous hairs: calyx finely hispid: corolla rose-color: pods glandular-hispid. — S. Colorado and southward.

12. GLYCYRRHIZA, L. LIQUORICE.

Flowers nearly as in *Astragalus*. Ovary sessile: style short and rigid. Pod compressed, and often curved. — Erect perennial herbs: flowers in dense axillary pedunculate spikes, with caducous bracts: root large and sweet.

1. **G. lepidota**, Pursh. Somewhat glandular-puberulent, or the younger leaves slightly silky: leaflets 6 to 8 pairs, oblong-lanceolate: spike short: flowers ochroleucous: pod thickly beset with hooked prickles. — From Colorado to New Mexico, westward into Nevada and N. California, and northward to Washington, and across the continent to Hudson Bay.

13. ASTRAGALUS, Tourn. RATTLE-WEED.

Corolla and its slender-clawed petals usually narrow. — Herbs, or a few woody at base: with rather small flowers, chiefly in simple axillary spikes or racemes: the peduncle commonly elongated. — Gray, Proc. Am. Acad. vi. 188. Watson, Bot. King's Exp. 435.

SERIES I. *Pod completely or imperfectly 2-celled by the intrusion of the dorsal suture, the ventral suture being not at all or less deeply inflexed.* — ASTRAGALUS, L.

Artificial Key.

- | | |
|-----------------------------------------------------------------------------------------------------|----------------|
| Pod succulent, becoming thick and fleshy, sessile | Nos. 1, 2, 3 |
| Pod not 2-celled, inflated, not mottled, sessile; plant hirsute-canescens | 27 |
| Pod completely 2-celled, bladdery-inflated, often mottled, sessile; plant nearly glabrous | 4 |
| Pod coriaceous, cartilaginous, or chartaceous, not bladdery-inflated, | |
| 1. Conspicuously stipitate, the stipe about equalling or surpassing the calyx, | |
| Not sulcate | 20, 21 |
| Deeply sulcate, | |
| Pod glabrous, pendent | 14, 15, 16 |
| Pod black-hairy | 24 |
| 2. Short-stipitate, | |
| Not sulcate | 22 |
| Sulcate, | |
| Incurved, mottled | 25 |
| Straight, | |
| Completely 2-celled | 11, 13 |
| Incompletely 2-celled | 23, 26 |
| 3. Sessile. | |
| Completely 2-celled, | |
| Glabrous | 5, 7 |
| Pubescent or hoary | 8, 9, 10, 12 |
| Villous or woolly | 6 |
| Incompletely 2-celled. | |
| Stems a span or more high | 18, 19 |
| Stems not rising so high, or none at all, | |
| Pod straight or nearly so | 17, 28 |
| Pod curved | 29, 30, 31, 32 |

Systematic Synopsis.

- § 1. *Pod plum-shaped, succulent, becoming thick and fleshy, indehiscent, not stipitate, completely 2-celled.* — Perennials, with low leafy stems: stipules distinct, nearly free: racemes short, spike-like.

* Ovary and pod glabrous.

1. **A. caryocarpus**, Ker. *Grayish with an appressed pubescence: flowers violet: pod globose or ovate, usually pointed.* — Plains from the Saskatchewan to Texas.

2. **A. Mexicanus**, A.DC. *Taller, greener, less pubescent: flowers lighter-colored or white: calyx softly white-villous or tomentose: pod ovate-globose, scarcely pointed.* — From Colorado to Missouri and S. Texas.

** Ovary hoary-hirsute: pod sometimes becoming glabrate.

3. **A. Plattensis**, Nutt. *Loosely villous: flowers ochroleucous or purplish above: pod ovate, acuminate, or oblong and somewhat curved.* — From Colorado to Nebraska and Illinois, and southward to Texas and N. Alabama.

§ 2. *Pod* orate or globose, membranous, inflated, nearly glabrous, sessile, completely 2-celled and more or less didymous by the intrusion of both sutures, many-seeded. — *Stipules* distinct, adnate: *flowers* spicate.

4. **A. diphysus**, Gray. Nearly glabrous throughout: leaflets 6 to 11 pairs, obovate or oblong: flowers blue or purple, occasionally white: pod curved-acuminate, frequently mottled — S. W. Colorado, southward, and westward in the Great Basin.

§ 3. *Pod* cartilaginous or coriaceous, sessile, oblong, turgid, terete, sulcate at both sutures, at length incurved, completely 2-celled. — *Subacaulescent*, shining with a soft silky-villous often yellow pubescence: *peduncles* long, scape-like: *spikes* dense: *flowers* violet.

5. **A. mollissimus**, Torr. *Pod* narrow-oblong, 5 to 9 lines long, glabrous, subdidymous: ovary also glabrous. — From Colorado to Nebraska and W. Texas.

6. **A. Bigelovii**, Gray. *Pod* oval-oblong, 6 lines long, densely woolly, but slightly sulcate. — From S. W. Colorado to Texas and Mexico.

§ 4. *Pod* coriaceous, turgid, oblong, terete, scarcely sulcate and only on the back, nearly straight, sessile, completely 2-celled. — Tall, with appressed gray pubescence or glabrate: *spikes* dense: *flowers* whitish, ochroleucous or purplish: *stipules* distinct or united, free.

7. **A. Canadensis**, L. Leaflets 10 to 14 pairs, elliptical or oblong, obtuse: *pod* and *ovary* glabrous. — From Colorado to the head-waters of the Columbia and Saskatchewan, and eastward to the Atlantic States.

8. **A. Mortoni**, Nutt. Differs from the last in the somewhat pubescent *ovary* and *pod*, and the latter more decidedly sulcate dorsally and less crowded in the matured spike, and the leaflets 6 to 8 pairs. — **A. Canadensis**, var. **Mortoni**, Watson. Head-waters of the Missouri and Platte, westward into Utah, Nevada, and California.

§ 5. *Pod* coriaceous, oblong or ovate, straight or slightly curved, usually more or less compressed-triangular, dorsally sulcate (cross-section obcordate), completely 2-celled, pubescent. — *Caulescent*, grayish short-pubescent or glabrate: *stipules* more or less sheathing.

9. **A. adsurgens**, Pall. Rather stout: *spikes* at length oblong or cylindrical: *flowers* purplish: *pod* sessile. — From Colorado to Oregon, Nebraska, and the Saskatchewan.

10. **A. terminalis**, Watson. Slender: leaves long-petiolate: raceme an inch long, open, long-pedunculate: flowers nearly sessile, reflexed, purplish: *pod* sessile, straight, erect. — Proc. Am. Acad. xvii. 370. S. Montana.

11. **A. hypoglottis**, L. Slender: flowers capitate, violet: *pod* silky-villous, very shortly stipitate. — From S. Colorado northward along the mountains and Red River Valley to Alaska and the Arctic Circle.

12. **A. ventorum**, Gray. Stems flexuous, 4 to 6 inches high, simple: leaflets broadly obovate: raceme loose, short-peduncled, equalling the leaves: flowers light yellow: *pod* sessile, slightly curved. — Watson in Am. Naturalist, viii. 212. Wind River, Wyoming, Parry.

§ 6. *Pod coriaceous, obovoid, straight, short-stipitate, dorsally sulcate, ventral suture rather prominent, completely 2-celled.* — *Low, caulescent: flowers very small, white or cream-color, tinged with purple.*

13. **A. Brandegei**, Porter. *Canescent with minute appressed hairs: branching from a somewhat woody base: leaflets linear: racemes on long peduncles, loosely few-flowered: pod hairy.* — Fl. Colorado, 24. Banks of the Arkansas near Cañon City, Colorado, Brandegee.

§ 7. *Pod exsert-stipitate, pendent, very glabrous, straight or falcate, narrow, more or less triangular, very deeply sulcate dorsally, the suture intruded to the middle or beyond.* — *Stems erect, stout, sulcate, very leafy: flowers in long crowded racemes, rather large.*

14. **A. Drummondii**, Dougl. *Softly villous: calyx scarcely gibbous at base, black-hairy: corolla white: pod long-linear, terete, cross-section obcordately 2-lobed.* — From Colorado to Nebraska and the Saskatchewan.

15. **A. scopulorum**, Porter. *Pubescent with appressed hairs: calyx gibbous at base, pilose with blackish hairs: corolla yellow or ochroleucous: pod oblong, becoming arcuate with age, sharply 3-angled, the dorsal suture with an acute sulcus on each side.* — Fl. Colorado, 24. *A. subcompressus*, Gray. Central and Southern Colorado.

16. **A. racemosus**, Pursh. *Appressed pubescent, glabrate: calyx strongly gibbous at base, whitish-puberulent: corolla white: pod lance-oblong, cross-section somewhat equally triradiate.* — From Colorado to Nebraska and Idaho.

§ 8. *Pod sessile, coriaceous, obcompressed, with the impressed dorsal suture more or less approaching the ventral, but not 2-celled.* — *Low or prostrate, with a fine hoary pubescence: flowers spicate, deep yellow.*

17. **A. flavus**, Nutt. *Diffuse: stipules sheathing the stem and base of the petiole, oblique: leaflets linear: pod half-included, hoary, ovate, straight.* — W. Wyoming, Parry, and westward.

§ 9. *Pod 2 to 3 lines long, sessile, elliptic-ovate, always wholly one-celled, the ventral suture thick and prominent.* — *Subcinereous: stems slender, rather rigid, a foot high or more: leaflets 5 to 8 pairs, linear: racemes spike-like: flowers purple to whitish.*

18. **A. gracilis**, Nutt. *Stems virgate: leaflets nearly filiform: racemes dense, elongated, long-peduncled: flowers pale purple or whitish: pods spreading, coriaceous, strongly concave on the back, white-hairy, at length glabrous, transversely rugose-veined.* — From Colorado to Nebraska and Missouri.

19. **A. microlobus**, Gray. *Stems diffuse: leaflets shorter, linear or oblong-linear: racemes rather short and usually loosely flowered: flowers deep purple: pods reflexed, thick-cartilaginous, puberulent, finely rugulose, a little flattened on the back, the ventral suture very thick.* — Proc. Am. Acad. vi. 203. From the Rocky Mountains to Missouri and Nebraska.

§ 10. *Pod stipitate, coriaceous or nearly membranous, scarcely or not at all obcompressed, 1-celled or imperfectly 2-celled.* — *Caulescent, slender: flowers in short often spike-like racemes, or few in small heads, purple to white, spreading.*

* *Pod membranous, glabrous or pubescent, slightly more compressed laterally, 1-celled with a very narrow rudimentary septum from the straight dorsal suture, the ventral suture gibbous.*

+ *Pod long-stipitate, not sulcate, cross-section oval: flowers white or bluish, keel violet.*

20. **A. aboriginum**, Rich. *Hoary-pubescent or subcillous: stems numerous, rigid: leaflets 3 to 6 pairs, linear or oblong-lanceolate: pod semi-elliptic.* — Mountains of Colorado, northward throughout W. British America.

21. **A. glabriusculus**, Gray. Like the last: *glabrous or with short scattered hairs: leaflets thinner, green, linear-lanceolate: pod lanceolate-subfulcate, the stipe 2 to 3 times longer than the calyx.* — Proc. Am. Acad. vi. 204. Mountains of Colorado and British America.

+ + *Pod short-stipitate, cross-section obovate, pubescent with more or less nigrescent hairs: flowers white.*

22. **A. Robbinsii**, Gray, var. **occidentalis**, Watson. *Pod much compressed, tapering at base to a very short stipe, with no indication of a dorsal sulcus.* — Bot. King's Exp. 70. S. W. Colorado and Nevada.

* * *Pod more coriaceous, black- or rarely cinereous-pubescent, more or less triangular and semi 2-celled, the dorsal suture sulcate-impressed.*

+ *Pod lens-shaped, the cross-section obcordate, the ventral suture a little the more gibbous.*

23. **A. oroboides**, Hornem., var. **Americanus**, Gray. *Subcinereous-puberulent: stems 1 to 1½ feet high: leaflets 5 to 7 pairs, oblong and oval or often linear-oblong: flowers in a long second raceme, the wings exceeding the keel: pod with gray pubescence; stipe very short.* — Proc. Am. Acad. vi. 205. In the Rocky Mountains from Colorado northward into British America, thence eastward to Labrador.

+ + *Pod triangular, more impressed, the cross-section deeply obcordate, rather straight or incurved, gibbous on the back.*

24. **A. alpinus**, L. *Hairy-pubescent or glabrous: leaflets 6 to 12 pairs, oval or oblong: racemes short or subcapitate, many-flowered: wings little if at all exceeding the rather large keel: pod straight or recurved, black-villous or pubescent; stipe usually exceeding the calyx.* — Colorado, Wyoming, and northward to Arctic America; also in Maine and Vermont.

25. **A. sparsiflorus**, Gray. *Slightly appressed-pilose, glabrate: leaflets 4 to 6 pairs, obovate or subrounded: peduncles 3 to 10-flowered: the emarginate or bifid banner and the wings much exceeding the incurved keel: pod incurved, mottled; stipe very short.* — Proc. Acad. Philad. 1863, 60. Colorado.

§ 11. *Closely resembling the last, but villous or canescent, lower, and with yellowish flowers: pod semi-ovate or oblong, turgid, coriaceous, subtriangular, with the back gibbous and more or less impressed, the ventral suture prominent.*

26. **A. lotiflorus**, Hook. *Heads few-flowered: corolla little exceeding the calyx: the cross-section of the pod obovate, retuse, or usually broadly obcordate toward the base.* — From Colorado and Wyoming to Texas, Nebraska, and Hudson Bay.

§ 12. *Pod sessile, mostly thick coriaceous and obcompressed, the impressed dorsal suture more or less approaching the ventral, not 2-celled, pubescent.* — Low, white-silky or hoary: *flowers spicate or subcapitate, usually violet or purplish*

* *Annual or biennial, many-stemmed: flowers rather small: pod inflated, membranous, incurved.*

27. **A. pubentissimus**, Torr. & Gray. Dwarf, hirsute-canescens: leaflets oblong or obovate: flowers few: pod villous, ovate-lunate, strongly incurved. — Colorado and W. Wyoming.

* * *Perennial, short-stemmed or scarcely caulescent, usually prostrate or matted: flowers rather large: pod thick-coriaceous, obcompressed-triangular, transversely rugulose.*

28. **A. Missouriensis**, Nutt. Subcaulescent, hoary-silky with a short very closely appressed pubescence: peduncles scape-like, capitately or spicately few-flowered: pod nearly straight, blackish, elliptic. — From New Mexico to Nebraska and the Saskatchewan.

29. **A. Shortianus**, Nutt. Usually subcaulescent, silky-canescens with a very closely appressed pubescence: leaflets obovate or ovate: pod strongly arcuate, thick, puberulent, ovate-lanceolate to lanceolate-linear. — Includes *A. cyaneus* of most of the western reports. From Colorado to Nebraska and westward; also southward into New Mexico.

30. **A. Parryi**, Gray. Stems short, villous, with loose spreading hairs: flowers loosely subcapitate, whitish or yellowish, the keel tinged with purple: pod arched or at length circinate, pubescent, oblong-lanceolate, strongly obcompressed and rugulose, both sutures sulcately impressed, contiguous. — Am. Jour. Sci. II. xxxiii. 410. From Colorado to N. W. Texas.

31. **A. iodanthus**, Watson. Canescens with an appressed hairy pubescence, or usually nearly glabrous with scattered hairs upon the petioles and margins of the leaves: stems decumbent: leaflets obovate or orbicular: spikes short, dense: pod strongly arcuate or hamate, nearly glabrous, mottled, linear-oblong, irregularly folded. — Bot. King's Exp. 70. Colorado (Coulter) and Nevada.

32. **A. glareosus**, Dougl. Depressed, villous-silky with white incumbent hairs: flowers 3 to 6: pod incurved, silky-pubescent becoming subglabrous, oblong-ovate, attenuate above. — Wyoming and S. Idaho.

SERIES II. *Pod one-celled, neither suture being inflexed or the ventral more intruded than the dorsal.* — PHACA, L.

A. *Leaves pinnate with many or rarely with few or abortive leaflets, or simple.*

Artificial Key.

Leaflets prickly pointed and rigid, persistent	No. 61
Leaflets not prickly pointed.	
Pod inflated,	
Stipitate,	
Mottled	36
Not mottled.	
Stipe very short	37
Stipe equalling or exceeding the calyx	38, 39
Sessile.	
Annual; pod 7 to 12 lines long	34, 35
Perennial; pod 2 to 4 lines long	40, 41, 42, 43
Pod coriaceous or cartilaginous, not bladderly inflated,	
Exsert-stipitate,	
Deeply sulcate	44, 45
Not deeply sulcate	53

Short-stipitate,	
Glabrous	50, 52
Puberulent	49, 51
Sessile,	
Glabrous	46, 47, 60
Puberulent or pubescent.	
Stems a span or more high	56, 57, 58
Cespitose	54, 55, 59
Woolly or villous	33, 48

Systematic Synopsis.

§ 13. *Pod* very woolly, short, turgid, coriaceous, incurved, sessile.—*Very soft-woolly: stems short, prostrate, from a stout perennial root: flowers usually one inch long, loosely subcapitate.*

33. **A. Purshii**, Dougl. Nearly acaulescent, rarely 6 inches high, canescent with a long and dense woolly pubescence: leaflets lanceolate or oblong: flowers ochroleucous, with the keel sometimes purplish.—W. Wyoming to California and Oregon.

§ 14. *Pod* membranous, inflated, globose, egg-shaped or semi-ovate, usually large, finely reticulated, glabrous or glabrate.

* *Annual: pod sessile, not mottled: flowers small, ochroleucous or purplish. Low, leaflets linear or linear-oblong, gray with strigulose hairs.*

34. **A. triflorus**, Gray. Cinereous-pubescent, very much branched from the base, branches ascending, 6 to 12 inches high: flowers 3 to 15: *pod* oval, obtuse or acutish.—Pl. Wright. ii. 45. S. Colorado and southward into Mexico.

35. **A. Geyeri**, Gray. Somewhat simple, 3 to 6 inches high, subcanescent, with an appressed hairy pubescence: leaflets glabrous above: flowers 3 to 5: *pod* ovate-lunate with an incurved acumination.—Proc. Am. Acad. vi. 214. Wyoming, Idaho, and W. Nevada.

* * *Annual or perennial: pod stipitate.*

+ *Pod mottled: stipe equalling the calyx: flowers few, rather small.*

36. **A. pictus**, Gray. Hoary with a loose silky pubescence: leaflets 3 to 7 pairs, narrowly linear or filiform, most of them usually abortive: *pod* ovoid, scarcely pointed, pendent.—Proc. Am. Acad. vi. 214. From Nebraska to Idaho and New Mexico. In sandy places.

Var. **filifolius**, Gray. Leaves usually imperfect; leaflets very few, mostly attenuated, the terminal one or the filiform rachis produced, persistent.—Loc. cit. 215. On the plains of Colorado and southward.

+ + *Pod not mottled.*

+ + *Nearly stemless, few-flowered: leaflets 4 to 6-paired: pod with a very short stipe.*

37. **A. megacarpus**, Gray. Glabrous: leaflets broadly oval or ovate: scape much shorter than the leaves: flowers ochroleucous or whitish: *pod* ovate-oblong, acuminate, very obtuse at base.—Loc. cit. 215. "Plains of the Rocky Mountains" (Nuttall).

++ ++ *Caulescent, rather tall, leafy: leaflets 7 to 9-paired: racemes or spikes mostly many-flowered: pod with a stipe equalling or exceeding the calyx.*

38. **A. frigidus**, Gray, var. **Americanus**, Watson. Subglabrous: leaflets ovate- or elliptic-oblong: peduncles equalling the leaves: flowers white: pod oblong, acute at each end, black-hairy or glabrous. — Bibl. Index, i. 193. *A. frigidus* of Bot. King's Exp., Hayd. Rep. 1871, and Fl. Colorado. In the mountains from Colorado to the Arctic regions.

§ 15. *Pod membranous, lanceolate-cylindric, straight, exsertly-stipitate, glabrous: flowers rather large: leaflets few or almost none.*

39. **A. lonchocarpus**, Torr. Ashy-puberulent, glabrate: stem fistulous, branched: leaflets filiform-linear, remote, the leaf sometimes reduced to the flattened-filiform rachis: racemes loosely many-flowered: flowers white, pendent: pod very sharply acuminate at each end. — Pac. R. Rep. iv. 80. S. Colorado to New Mexico and Utah.

§ 16. *Pod membranous or chartaceous, small, globose or ovate, inflated, sessile. — Diffuse or procumbent, mostly small and slender: flowers small and usually few.*

40. **A. microcystis**, Gray. Ashy-pubescent, from a woody root: leaflets 4 to 6 pairs, oblong or oblong-lanceolate, obtuse: racemes 5 to 12-flowered: corolla violet or whitish: pod globose-ovate, 3 lines long, thin membranous, gray-pubescent. — Proc. Am. Acad. vi. 220. W. Wyoming (Parry) and Washington.

41. **A. leptaleus**, Gray. Nearly glabrous: leaflets 7 to 11 pairs, lance-linear or oblong, often acute: peduncles 2 to 4-flowered: corolla white: pod ovate or oval, 4 lines long, chartaceous, puberulent. — Loc. cit. Colorado.

42. **A. jejunos**, Watson. Dwarf, minutely hoary-pubescent: stems 1 to 2 inches long, crowded, from a many-branching caudex, covered with numerous imbricated stipules, which are membranous, sheathing, truncate and ciliate: leaflets 4 to 7 pairs, linear: peduncles 2 to 3-flowered: corolla ochroleucous or tinged with violet: pod gibbous dorsally, obtuse, 4 lines long, membranous, glabrous. — Bot. King's Exp. 173, t. 13. Bear River Valley, near Evanston (Watson).

43. **A. humillimus**, Gray. Habit of the last, but much more dwarf and condensed: stems scarcely an inch long, with the scarious coalescent stipules imbricate and petioles persistent and spinescent: leaflets 3 to 5 pairs, oblong, canescent, with revolute margins: peduncles 1 to 3-flowered: corolla pale: pod ovate, 2 lines long, coriaceous, with a white pubescence. — Proc. Am. Acad. xii. 57. Often choked in drifting sand. Mesa Verde, S. W. Colorado (Brandegge).

§ 17. *Pod coriaceous, shortly exsert-stipitate, straight, narrowly oblong, semi-cylindric, the deeply concave ventral surface divided by the salient obtuse suture.*

44. **A. bisulcatus**, Gray. Strigulose-puberulent: stem over a foot high, stout: leaflets oblong, often narrower: flowers violet, in dense spike-like racemes, middle-sized: calyx-teeth scarcely shorter than the tube. — Pac. R. Rep. xii. 42, t. 1. From Colorado to Nebraska and the Saskatchewan.

45. **A. Haydenianus**, Gray. Smaller, pubescence more cinereous: spike elongated, virgate: flowers much smaller: calyx-teeth much shorter than the tube: corolla white, keel tinged with purple at the end: pod rugulose with transverse veins: stipe not exceeding the calyx. — Proc. Am. Acad. xii. 56. Colorado.

§ 18. *Pod* thick-cartilaginous with a subfleshy epicarp, subovate or oblong, turgid, sessile, neither suture intruded, but both thick and prominent. — Perennial, a foot high, stem and leaves rather rigid: leaflets nearly filiform, not jointed to the rachis, persistent.

46. **A. pectinatus**, Dougl. Ashy puberulent, glabrate: branches striate, angled: flowers white, the banner elongated: pod pendulous, glabrous, cuspidate, the dorsal suture very thick. — From Colorado to Nebraska and the Saskatchewan.

47. **A. Grayi**, Parry. Distinguished from the last by the broader leaflets, quite strongly veined, and by the somewhat thinner ascending pod: flowers light yellow. — Watson in Am. Nat. viii. 212. W. Wyoming (Parry).

§ 19. *Pod* coriaceous, ovate or oblong, rarely cylindrical, turgid, not sulcate and neither suture intruded. — Ours are perennials and the pods are sessile or scarcely stipitate.

* Nearly acaulescent, silvery-silky, large-flowered.

48. **A. Newberryi**, Gray. Stems very short, crowded from a deep elongated root: leaflets 3 to 7, either broad- or narrow-obovate, approximate: peduncles few-flowered: corolla ochroleucous: pod villous, the broad point laterally compressed, subincurved. — Proc. Am. Acad. xii. 55. *A. Chamæluce*, Gray, in part. On the borders of Utah, Arizona, and S. W. Colorado.

* * Glabrous or pubescent, stems ascending or erect: pod very shortly stipitate or sessile: calyx gray or dark-pubescent.

49. **A. Fendleri**, Gray. Glabrous or appressed puberulent, erect: leaflets oblong or linear-oblong: racemes loosely purple-flowered: pod straight, minutely puberulent, very shortly stipitate. — Pl. Wright. ii. 44. Colorado and New Mexico.

50. **A. Hallii**, Gray. Subcinereous-pubescent, glabrate, ascending: leaflets narrow-oblong, subcuneate, retuse: flowers violet, in a dense head-like raceme: pod straight, glabrous, with stipe a line long. — Proc. Am. Acad. vi. 224. Colorado to New Mexico.

51. **A. flexuosus**, Dougl. Ashy-puberulent, ascending: leaflets oblong- or cuneate-linear, obtuse or retuse: racemes mostly elongated, loose: corolla white or purplish: pod cylindric, puberulent, straight or subincurved, stipe very short but evident. — From Colorado to Nebraska and the Saskatchewan.

52. **A. Pattersoni**, Gray. Robust, a foot or two high, appressed-puberulent, sometimes glabrous: leaflets oblong, thickish: peduncles racemosely many-flowered: corolla white, the keel sometimes purplish at the tip: pod glabrous, abruptly contracted within the calyx, becoming somewhat stipe-like. — Loc. cit. xii. 55. S. W. Colorado and Utah.

§ 20. *Pod* vetch-shaped, flattened or less compressed, straight, margined by the nerve-like sutures, coriaceous or chartaceous, sometimes stipitate. — Perennials, with the leaves pinnate with many or few leaflets, or in some species simple.

* Flowers in peduncled racemes or spikes: pod many (7 to 20)-ovuled.

+ Stipules connate, at least the lower ones: pod exsert-stipitate. Caulescent: leaves pinnate, with many leaflets.

53. **A. multiflorus**, Gray. Somewhat glabrous: stems slender: stipules dark-colored: leaflets 6 to 10 pairs, linear or narrowly oblong: pedun-

cles not exceeding^k the leaves, loosely few-flowered: flowers ochroleucous, tinged with purple: pod oblong, reflexed. — Proc. Am. Acad. vi. 226. From Colorado to the plains of Nebraska, northward to lat. 65°, and westward to Utah, Nevada, and S. California.

— + *Stipules as before: pod sessile. Caulescent.*

++ *Calyx-teeth very slender, exceeding the tube. Low, from a woody caudex: the stipules all more or less connate.*

54. **A. pauciflorus**, Hook. Dwarf, cinereous-pubescent, matted-decumbent, with crowded leaves: leaflets 3 to 5 pairs, oblong or lanceolate: peduncles 2 to 5-flowered: corolla violet: pod linear-oblong, silky-puberulent, 4 to 5 lines long. — From the head-waters of the Yellowstone northward in the mountains of British America.

55. **A. tegetarius**, Watson. Dwarf, cespitose, canescent with a silky pubescence: stems 2 to 6 lines long, numerous, procumbent: leaflets 3 to 5 pairs, linear: peduncles 1 to 3-flowered: corolla ochroleucous: pod ovate-oblong, pubescent, 2 to 3 lines long. — Bot. King's Exp. 76, t. 13. Nevada, Idaho, and Montana.

Var. **implexus**, W. M. Canby. Leaflets in 2 pairs, crowded on the stems: stipules tipped with a short straight point: flowers violet, the keel deep purple: pods mostly smaller, 1 or 2 lines long. — Fl. Colorado, Appx. South Park, Colorado.

++ ++ *Calyx-teeth short or about equalling the tube. Slender, rather rigid, branched: upper stipules nearly distinct: leaflets linear to oblong, or none: flowers in loose long-peduncled racemes, ochroleucous or purplish.*

56. **A. campestris**, Gray. Minutely pubescent or glabrate: stipules membranous, large; leaflets 5 to 9 pairs: flowers subcapitate or scattered, the keel with a long and narrow inflexed tip: pod oblong-linear, puberulent. — Proc. Am. Acad. vi. 229. Mountains of Colorado and northward through Montana.

57. **A. decumbens**, Gray. Cinereous- or silky-pubescent: stems diffuse or ascending: petioles sometimes somewhat flattened, mostly with 7 to 13 leaflets: racemes 5 to 10-flowered: keel with a short inflexed tip: pod broad-linear, straight or falcate, hoary puberulent. — Loc. cit. Mountains of Colorado and northward.

58. **A. junceus**, Gray. Minutely pubescent or subglabrous: stems usually solitary, erect: stipules small: petioles slender, sometimes 6 inches long, usually naked, or with 1 to 5 pairs of linear leaflets: peduncles 3 to 7-flowered, flowers distant: keel strongly incurved: pod oblong-linear, straight or subfalcate, pubescent. — Loc. cit. 230. Includes *A. diversifolius*, Gray. Gravelly plains, from Colorado northward through Wyoming and Montana, and westward into Utah and Nevada.

+ + + *Stipules scarious, connate: pod short, sessile. Acaulescent, cespitose, silky-canescens: leaves simple, lanceolate- or spatulate-linear: scapes exceeding the leaves, many-flowered: corolla purple or rose-color.*

59. **A. cæspitosus**, Gray. Racemes spike-like: pod oblong or broad-lanceolate, scarcely curved. — Loc. cit. Plains of the Platte from W. Nebraska to the mountains.

* * Cushioned: flowers scarcely exerted from among the simple leaves: pod many-ovuled, margined with rather strong sutures.

60. **A. simplicifolius**, Gray. Leaves hoary with an appressed silky pubescence, linear- or spatulate-lanceolate, crowding the extremities of the usually short branches: scapes 2 to 3-flowered: flowers purple, the keel strongly arched: pod half-included in the calyx, glabrous.—Loc. cit. 231. Sources of the Platte. W. Wyoming (Parry).

* * * *Caulescent, often depressed: flowers subsessile in the axils of the leaves: pods 3 to 4-ovuled, usually 1-seeded, ovate, sessile: leaves pinnate, with few leaflets*

61. **A. Kentrophyta**, Gray. Intricately branched from a long root, broadly depressed-cespitose, hoary with a short silky pubescence: leaflets 2 to 3 pairs, linear-subulate, usually rigid and divaricate, pungent: flowers 1 to 3, ochroleucous or tinged with violet: pods compressed, pubescent, acuminate, somewhat incurved.—Proc. Acad. Philad. 1863, 60. From Montana and Wyoming to New Mexico and westward into Nevada.

B. *Leaves apparently palmately 3-foliate.*

§ 21. *Pod conical-ovate, acuminate, not stipitate nor compressed, coriaceous, somewhat included in the calyx, neither suture intruded.—Perennial, caespitose from a much-branched woody caudex, low, silvery-silky, with crowded leaves: leaflets crowded.*

62. **A. triphyllus**, Pursh. Acaulescent, glossy silky: stipules glabrous: primary leaves sometimes 5-foliate with cuneate oblanceolate leaflets, the rest with 3 longer lanceolate leaflets, long-petioled, exceeding the sessile crowded flowers: calyx-teeth half shorter than the tube: corolla ochroleucous or white: pod villous, included.—From Nebraska to the Saskatchewan.

63. **A. tridactylus**, Gray. Resembling the last in habit and leaves, but stipules villous, flowers pale purple, calyx-teeth equalling the tube, pod puberulent, exposed by the falling away of the calyx.—Proc. Am. Acad. vi. 527. Mountains of Colorado.

64. **A. sericoleucus**, Gray. Very broadly caespitose, silky-hoary: the branches covered with villous stipules: leaves all 3-foliate, not equalling the 2 to 6 flowered filiform peduncles: leaflets oblanceolate or cuneate oblong: calyx-teeth about equalling the tube: corolla purple: pod hoary, half included in the calyx.—Am. Jour. Sci. ii. xxxiii. 410. From the sand-hills of N. Colorado to N. Nebraska.

14. OXYTROPIS, DC.

Like *Astragalus*, but distinguished by a subulate beak at the tip of the keel.—Mostly low perennials, with tufts of numerous very short stems from a hard and thick root or rootstock, covered with scaly adnate stipules: pinnate leaves of many leaflets: naked scapes bearing a head or short spike of flowers.—Rev. Oxyt., Gray in Proc. Amer. Acad. xx.

§ 1. *Stipules free from the petiole and from each other: leafy-stemmed or depauperate plants nearly stemless.*

1. **O. deflexa**, DC. Loosely soft-pubescent or silky: taller forms over a foot high: leaflets crowded in 12 to 16 pairs, lanceolate to oblong, $\frac{1}{4}$ to $\frac{1}{2}$ inch

long: peduncles much surpassing the leaves: flowers rather small (about $\frac{1}{2}$ inch long), in a short and close or in fruit lengthened and open spike: pod oblong-lanceolate, not stipitate, 1-celled, much surpassing the calyx. — In the mountains from British America to S. Colorado and westward to Utah. Sub-alpine forms are often depauperate and almost stemless.

§ 2. *Stipules adnate to the petiole, imbricated on the short branches of the caudex which bears the scapes and leaves: no other ascending stems.*

* *Most of the numerous leaflets as if verticillate or fascicled in threes or fours or more along the rachis: scape spicately several to many-flowered: pod ovate, 2-celled, hardly surpassing the very villous calyx.*

2. **O. splendens**, Dougl. Silvery silky-villous, 6 to 12 inches high: flowers erect-spreading: pod erect. — Whole length of the Rocky Mountains, and plains along their eastern base, to the Saskatchewan.

* * *Leaflets simply pinnate.*

+ *Pod wholly enclosed in the bladderly ovate-globose calyx, turgid-ovate, one-celled: peduncles weak, 1 to 2-flowered.*

3. **O. multiceps**, Nutt. Matted cespitose, subcaulescent, 1 to 3 inches high, canescently silky: leaflets 3 to 4 pairs: flowers purple: pod short-stipitate — Alpine region of the Rocky Mountains, S. Wyoming and Colorado. Nuttall's specimens are larger-leaved and less cespitose than those of subsequent collectors distributed as var. *minor*, Gray.

+ + *Pod nearly or quite enclosed in and completely filling the distended and often split fructiferous calyx, turgid, pubescent, half two-celled: scapes capitately few to several-flowered, surpassing the leaves, a span high: flowers over $\frac{1}{2}$ inch long.*

4. **O. nana**, Nutt. Silvery with appressed silky pubescence: leaflets 3 or 4 or rarely 6 pairs, narrowly lanceolate: flowers purple or whitish: pod turgid-oblong, somewhat coriaceous, the acuminate tip barely projecting out of the undivided lightly villous calyx. — Torr. & Gray, Fl. May be *O. argentea*, Pursh, Fl. ii. 473. Mountains of Wyoming and Montana.

5. **O. lagopus**, Nutt. White silky with looser and more villous hairs: leaflets 4 or 5 pairs, lanceolate or oblong: flowers bright violet: pod ovate, thin-membranaceous and almost bladderly, obtuse, abruptly tipped with the persistent style, slightly surpassing the calyx which soon splits down one side. — Jour Acad. Philad. vii. 17 Mountains of Wyoming and Montana.

+ + + *Pod well surpassing the calyx; this at length split down one side or remaining unchanged.*

+ + *Bladderly-inflated and membranaceous, ovate, one-celled: scapes or peduncles few-flowered, in fruit usually decumbent: very low and depressed-tufted plants.*

6. **O. podocarpa**, Gray. Villous, or in age glabrate: leaflets 5 to 11 pairs, linear-lanceolate (3 or 4 lines long): peduncles 2-flowered, not surpassing the leaves: flowers comparatively large (7 or 8 lines long), violet: pod large (often an inch long), broadly ovate, puberulent, short-stipitate, neither suture at all introflexed. — Proc. Am. Acad. vi. 234. *O. Hallii*, Bunge. Alpine and subalpine, from S. Colorado to British America and perhaps to the Arctic regions.

7. **O. oreophila**, Gray. Silky-canescant: leaflets 3 to 5 pairs, lanceolate to oblong (2 to 4 lines long): scapes commonly surpassing the leaves, capitately 4 to

8-flowered: flowers only 4 or 5 lines long, apparently purple: *pod hardly $\frac{1}{2}$ inch long*, oblong-ovate, cinereous-pubescent, not at all stipitate, the ventral suture moderately introflexed.—Proc. Am. Acad. xx. 3. A species of S. California and Utah, collected on Aquarius Plateau, Utah, by L. F. Ward; probably to be found within our southwestern boundaries.

++ ++ *Pod oblong or narrower, not bladdery-inflated, coriaceous, nearly or quite 2-celled: scape 1 to 3-flowered.*

8. **O. Parryi**, Gray. Silky-canescens: leaves and scapes about a span high: leaflets 7 to 9 pairs, oblong-lanceolate (2 or 3 lines long): calyx short, cinereous-pubescent: pod nearly $\frac{1}{2}$ inch long, terete with a strong ventral groove, grayish-pubescent, not at all stipitate.—Proc. Am. Acad. xx. 4. *O. arctica* of Hall & Harbour's collection, no. 143. *O. Uralensis*, var. *pumila*, of Western Reports. Mountains of Colorado near the limit of trees.

++ ++ ++ *Pod nearly terete, turgid, but not bladdery-membranaceous, not stipitate or rarely obscurely so: scape capitately or spicately several to many-flowered.*

= *More or less glandular viscid, at least the calyx and commonly the pod.*

9. **O. viscida**, Nutt. Leaflets numerous and small (2 to 4 lines long), thickish, oval or oblong, often pubescent when young, at maturity green and glabrate: flowers in a dense oblong head or at length in a short spike, less than $\frac{1}{2}$ inch long: calyx villous and with sessile glands usually evident: pod small (3 to 5 lines long), puberulent, oblong, thin-chartaceous, half 2-celled, the small beak or point straight.—Torr. & Gray, Fl. i. 341. In the mountains from British America to Colorado; common in Wyoming.

= *Not glandular nor viscid: leaves more or less silky at least when young.*

10. **O. monticola**, Gray. Loosely silky-villous, at least the scapes (5 to 9 inches high) and calyx: leaflets sometimes glabrate, oblong or lanceolate (3 to 7 lines long): *spike oblong or cylindraceous, dense even in fruit: flower hardly $\frac{1}{2}$ inch long*: pod ovate-oblong, between membranaceous and chartaceous, $\frac{1}{3}$ to $\frac{1}{2}$ inch long, tipped with a straight point, one-celled with no introflexion of the ventral suture, or nearly half 2-celled, silky-canescens.—Proc. Am. Acad. xx. 6. *O. campestris* of Hook. Fl. Bor. Am. in part. Mountains of Wyoming, South Dakota, and northward.

11. **O. Lamberti**, Pursh. Commonly taller as well as larger (the scapes often a foot or more high), silky- and mostly silvery-pubescent, sometimes glabrate in age: leaflets from oblong-lanceolate to linear (4 to 16 lines long): *spike sometimes short-oblong and densely flowered at least when young, often elongated and sparsely flowered: flowers mostly large* (often an inch long, but sometimes much smaller), variously colored: pod either narrowly or broadly oblong, sericeous pubescent, firm-coriaceous, $\frac{1}{2}$ inch or more long, imperfectly 2-celled.—Includes *O. campestris* of Hook. Fl. Bor. Am. in part. Common along the Great Plains from the Saskatchewan and Minnesota to New Mexico, Texas, etc., and in the foothills.

Var. **sericea**, Gray, is a robust mountain form, canescens with the silky pubescence; the leaflets mostly broad (3 or 4 lines), and the cylindraceous pods nearly or quite an inch long.—*O. sericea*, Nutt. in Torr. & Gray, Fl. i. 339.

Var. **Bigelovii**, Gray, is a marked form, with pods of the preceding form, but more slender, of thinner texture, and short-stipitate; leaflets green

and glabrate, narrow.—The *O. Lamberti* of Torr. in Pacif. R. Rep. iv. 80. On the Upper Canadian River, Colorado, *Bigelow*.

15. HEDYSARUM, Tourn.

Keel nearly straight, obliquely truncate, not appendaged, longer than the wings. Pod flattened, the separable joints roundish and equal-sided.—Perennial herbs.

1. *H. Mackenzii*, Richard. Stems 2 feet high, minutely pubescent, simple or branched: leaflets 11 to 17 (usually 11), *canescently pubescent*, nearly glabrous above: *racemes loosely 7 to 30-flowered, elongating in fruit*: flowers large, light purple: *pod 2 to 4-jointed, minutely pubescent*.—From Colorado northward to the Arctic regions.

2. *H. boreale*, Nutt. Leaflets 13 to 21, *nearly glabrous*: *raceme of many deflexed purple flowers*: *pod 3 or 4-jointed, smooth, reticulated*.—From W. Wyoming (*Parry*) northward throughout British America to the Arctic Circle.

16. VICIA, Tourn. VETCH. TARE.

Wings adherent to the middle of the short keel. Style inflexed. Pod flat, smooth. Seeds globular.—Herbs, with angular stems, more or less climbing: leaflets entire or toothed at the apex: stipules semi-sagittate: flowers solitary or in loose peduncled axillary racemes.

* *Perennial: peduncles 4 to 8-flowered.*

1. *V. Americana*, Muhl. Usually rather stout, 1 to 4 feet high, glabrous: leaflets 4 to 8 pairs, very variable, linear to ovate-oblong, truncate to acute: peduncles 4 to 8-flowered: flowers purplish: pod oblong, 3 to 6-seeded.—Throughout the whole of our range and extending to Washington and New Mexico and eastward across the continent.

Var. *truncata*, Brewer. Usually somewhat pubescent: *leaflets truncate* and often 3 to 5-toothed at the apex.—Bot. Calif. i. 158. *V. truncata*, Nutt. From Colorado and northward to Washington.

Var. *linearis*, Watson. *Leaves all linear*.—Proc. Am. Acad. xi. 134. *Lathyrus linearis*, Nutt. From the Rocky Mountains westward to California, being the common western form of the species.

* * *Slender annuals: peduncles 1 or 2-flowered.*

2. *V. exigua*, Nutt. A span to two feet high, *more or less pubescent*: *leaflets about 4 pairs, linear, acute*: peduncles rarely 2-flowered: flowers purplish: *pod linear-oblong*.—Torr. & Gray, Fl. i. 272. S. Colorado and New Mexico, westward to California.

3. *V. micrantha*, Nutt. Stem 2 to 3 feet long, strongly angled, *glabrous*, climbing: leaflets 2 to 6 pairs (*usually 2 pairs*), *oblong-elliptical, obovate or linear-oblong, obtuse or emarginate*, mucronate: peduncles at first much shorter than the leaves: flowers pale, blue at the tip: *pod sabre-shaped*, sessile.—Loc. cit. 271. From Colorado to Texas and Louisiana.

17. LATHYRUS, L. EVERLASTING PEA.

Nearly as in *Vicia* except the characters given in the synopsis of genera. All of ours have long peduncles.—Watson, Proc. Am. Acad. xi. 133.

§ 1. *Rachis of the leaves tendril-bearing: pod sessile. Ours are perennials, with semi-sagittate stipules having lanceolate lobes, and purple or purplish flowers.*

* *Leaflets 8 to 12: peduncles rather many-flowered.*

1. **L. venosus**, Muhl. Stout, climbing, usually somewhat downy: leaflets oblong-ovate, mostly obtuse: calyx densely pubescent to nearly glabrous: pod smooth. — Throughout the Eastern States and extending northwestward to Washington.

* * *Leaflets 4 to 8: peduncles 2 to 6-flowered.*

2. **L. paluster**, L. Slender, glabrous or somewhat pubescent: stem often winged: leaflets narrowly oblong to linear: flowers smaller (6 lines long). — Common everywhere throughout the northern portions of both hemispheres.

Var. **myrtifolius**, Gray. Stipules usually broader and larger; leaflets ovate to oblong, shorter (an inch long or less). — Pl. Fendl. 30. *L. myrtifolius*, Muhl. *L. venosus*, var. ♂, Torr. & Gray, Fl. i. 274. *L. polyphyllus*, Watson, Bot. King's Exp. 78. The *L. pubescens*, Nutt., of Fl. Colorado. With the species.

§ 2. *Rachis not tendril-bearing or rarely so: pod shortly stipitate. In ours the peduncles are 2 to 6-flowered.*

3. **L. polymorphus**, Nutt. Usually low, finely pubescent or glabrous, glaucous: leaflets 6 to 12, thick and strongly nerved, narrowly oblong, acute: flowers very large, purple: pod 3 or 4 lines broad; funiculus remarkably narrow and hilum short. — Colorado and New Mexico to Central Arizona.

4. **L. ornatus**, Nutt. Resembling the last except the leaves are narrower and shorter, the pod somewhat broader, and the funiculus broader. — Torr. & Gray, Fl. i. 277. Mountains of Colorado and Utah.

18. CASSIA, L. SENNA.

Calyx-tube very short. Anthers erect, opening by two pores or chinks at the apex. Pod usually curved, many-seeded, often with cross-partitions between the seeds. — Herbs, with flowers in terminal or axillary (in ours) clusters.

1. **C. Chamæcrista**, L. Leaflets small, somewhat sensitive to the touch, 10 to 15 pairs, linear-oblong, oblique at the base, a cup-shaped gland beneath the lowest pair: flowers on slender pedicels, in small clusters above the axils, 2 or 3 of the showy petals often with a purple spot at the base: four of the anthers yellow, the others purple. — Throughout the Eastern States and westward across the plains to Colorado.

19. HOFFMANSEGGIA, Cav.

Sepals united into a short obconic base. Petals obovate, on short claws, spreading, one or more of them often glandular at base. Filaments thickened or dilated toward the base. Pod oblong or linear, often falcate, compressed, dry, 2-valved. — Low perennial herbs or suffrutescent plants, often dotted with black glands.

1. **H. Jamesii**, Torr. & Gray. Canescently-pubescent, much branched from a shrubby base: pinnæ 5, abruptly 10 to 16-foliate: leaflets oval, nearly

glabrous above: flowers nodding or reflexed: *the upper petal smallest, marked with reddish spots*: pod 1 inch long, *more or less lunate, scabrous, 2 to 3-seeded, sprinkled (as well as the leaves, calyx, and petals) with sessile black glands.*—Fl. i. 393. Plains of E. Colorado, New Mexico, and Texas.

2. *H. drepanocarpa*, Gray. *Minutely cinereous-puberulent, wholly destitute of glands*: stems numerous, from a thick woody root: pinnæ 5 to 11, 8 to 20-foliolate; leaflets crowded, subfalcate, nerveless: petals broadly obovate, nearly alike, naked and glabrous: pod $1\frac{1}{2}$ to 2 inches long, *strongly falcate, glabrous or minutely puberulent under a lens, 9 to 10-seeded.*—Pl. Wright. i. 58. Colorado, New Mexico, and Arizona.

20. SCHRANKIA, Willd. SENSITIVE BRIAR.

Flowers polygamous. Calyx minute, 5-toothed. Pod long and narrow, 4-valved.—Perennial herbs, the procumbent stems and petioles prickly: leaves sensitive and of many small leaflets, the axillary peduncles bearing round heads of small rose-colored flowers.

1. *S. uncinata*, Willd. Prickles hooked: partial petioles 4 to 6 pairs: leaflets elliptical, reticulated with strong veins beneath: pod oblong-linear, nearly terete.—Throughout the S. E. States and westward across the plains to Colorado and the Dakotas.

ORDER 26. ROSACEÆ. (ROSE FAMILY.)

Herbs, Shrubs, or trees, with mostly alternate leaves, usually evident stipules, usually perigynous mostly numerous stamens, distinct free pistils from one to many, or coherent with each other and the calyx-tube, and anatropous seeds destitute of albumen or nearly so.

SUBORDER I. AMYGDALÆÆ.

Carpels solitary, or rarely 5, becoming drupes, entirely free from the calyx, this or its lobes deciduous. Ovules 2, pendulous, but seed almost always solitary. Style terminal.—Trees or shrubs, with bark exuding gum, and mostly (as well as the seeds) yielding the flavor of prussic acid. Stipules free, deciduous.

1. *Prunus*. Flowers perfect. Carpel solitary.

SUBORDER II. ROSACEÆ PROPER.

Carpels free from the persistent calyx, becoming akones, or follicles, or drupe-like in fruit. Stipules commonly adnate to the petiole. Calyx dry and open, or sometimes strictly enclosing the fruit, or fleshy and pome-like.

Tribe I. SPIRÆACEÆ. Carpels few, rarely solitary, becoming two to several-seeded follicles. Calyx open.

* Carpels alternate with the calyx-lobes when of the same number.

† Seeds with membranous testa and no albumen: stipules none.

++ Calyx persistent in fruit : stamens perigynous : carpels several-seeded.

2. **Spiræa.** Carpels cartilaginous, 1-valved, distinct. Flowers perfect, rarely polygamous. Leaves simple, serrate or incised.

++ ++ Calyx marcescent in fruit : stamens hypogynous : carpels few-seeded.

3. **Aruncus.** Carpels cartilaginous, 1-valved, distinct. Flowers dioecious. Leaves repeatedly ternately divided.

+ + Seeds with shining stony testa : albumen very distinct : stipules membranaceous, caducous.

4. **Physocarpus.** Follicles membranaceous, inflated, 2-valved, distinct, often stipitate. Flowers perfect, corymbose. Leaves lobed.

* * Carpels opposite to the calyx-lobes when of the same number.

5. **Chamaebatiaria.** Follicles coriaceous, 1-valved, connate at base, several-seeded. Albumen distinct. Flowers perfect. Leaves small, coriaceous, stipulate, bipinnately dissected.

*** Carpel becoming an akenes.

6. **Holodiscus.** Carpels alternate with the calyx-lobes, with densely silky styles and 2 collateral pendulous ovules. Akenes membranous, woolly, 1-seeded. Leaves lobed, without stipules.

Tribe II. RUBEÆ. Carpels several or numerous on a spongy receptacle, becoming drupelets in fruit. Calyx open, without bractlets. Stamens numerous. Ovules 2 and pendulous, but seed solitary.

7. **Rubus.** Carpels indefinitely numerous, berry-like in fruit. Perennial herbs or soft-woody shrubs with biennial stems.

Tribe III. POTENTILLEÆ. Carpels numerous, several, or solitary, 1-ovuled, becoming dry akenes. Calyx not enclosing or at least not constricted over the fruit. Seed erect or ascending.

* Shrubs : carpels mostly solitary : style not elongated in fruit : stigma decurrent : calyx imbricated, without bractlets. Flowers solitary in ours.

8. **Purshia.** Petals 5. Leaves 3-cleft. Radicle inferior.

9. **Coleogyne.** Calyx 4-parted, colored. Petals none. Leaves opposite, small, narrow, entire. Radicle superior.

* * Trees or shrubs : carpels solitary or numerous : styles elongated and plumose in fruit : calyx imbricated, without bractlets (except in *Fallugia*) : seed erect.

10. **Cercocarpus.** Flowers solitary, axillary, small. Petals none. Carpels solitary, rarely 2. Calyx-tube long-cylindrical ; the limb deciduous. Leaves simple, entire or toothed.

11. **Cowania.** Flowers solitary, short-peduncled, terminal, showy. Petals 5. Carpels 5 to 12. Calyx short and turbinate. Leaves cuneate, lobed.

12. **Fallugia.** Flowers somewhat panicled, on long peduncles, showy. Petals 5. Carpels numerous. Calyx turbinate. Leaves with linear lobes.

*** Herbs : carpels few to many : calyx concave or campanulate, valvate in the bud, bracteolate.

+ Seed erect from the base of the cell : radicle inferior : style strictly terminal, persistent.

13. **Dryas.** Like *Geum*, but petals 8 or 9.

14. **Geum.** Carpels very numerous on a dry receptacle : the elongated style in fruit mostly geniculate or plumose. Petals 5.

+ + Seed suspended or ascending : radicle superior : style small, naked, not geniculate.

15. **Fragaria.** Carpels very numerous, in fruit on a large fleshy scarlet receptacle. Styles lateral. Leaves 3-foliolate.

16. **Potentilla.** Petals yellow, rarely white, sessile. Stamens usually 20 or more ; filaments narrow or filiform. Carpels mostly numerous, on a dry receptacle. Leaves pinnate or digitate ; leaflets toothed or cleft, not confluent.

17. **Sibbaldia.** Petals yellow, sessile, minute and narrow. Stamens 5 ; filaments very short, filiform. Carpels 5 to 10, on a dry receptacle. Leaves 3-foliolate ; leaflets 3-toothed.

18. **Ivesia.** Petals yellow, with claws, or spatulate. Stamens 20; filaments filiform. Carpels 1 to 15, on a dry villous receptacle. Leaves pinnate; leaflets cleft or parted, often small and very numerous and closely imbricated.
19. **Chamærhodos.** Petals white, obovate. Stamens 5; filaments short, subulate. Carpels 5 to 10, on a dry villous receptacle. Leaves many-cleft; the segments linear.
- Tribe IV. POTERIEÆ.** Carpels 1 to 3, in fruit akenes, completely enclosed in the dry and firm calyx-tube, the throat of which is constricted or sometimes nearly closed. Seed suspended. Ours are herbs with pinnate leaves and solitary ovule.
20. **Agrimonia.** Calyx turbinate, surrounded by a margin of hooked prickles. Petals yellow. Stamens 5 to 12. Flowers in long racemes.
21. **Poterium.** Calyx-lobes 4, imbricate, deciduous, petaloid; the tube 4-angled, naked. Petals none. Flowers in dense heads.
- Tribe V. ROSEÆ.** Carpels many, in fruit bony akenes, enclosed and concealed in the globose or urn-shaped fleshy calyx-tube, which resembles a pome. Petals conspicuous. Stamens numerous.
22. **Rosa.** Erect shrubs, with pinnate leaves.

SUBORDER III. POMEÆ.

Carpels 2 to 5, enclosed in and mostly adnate to the fleshy calyx-tube, in fruit becoming a pome. A pair of ovules in each carpel. Styles often united below. — Trees or shrubs, with stipules free from the petiole or nearly so.

23. **Cratægus.** Ovary 2 to 5-celled; the fruit drupaceous, of 2 to 5 bony 1-seeded stones, either separable or united into one. Branches usually thorny.
24. **Pyrus.** Ovary 2 to 5-celled; the fruit a proper pome, with papery or cartilaginous and undivided 2-seeded cells or carpels.
25. **Amelanchier.** Ovary 5-celled; the cells 2-ovuled and 2-seeded, but in fruit each divided into two by a partition from the back. Styles 3 to 5. Otherwise like *Pyrus*.
26. **Peraphyllum.** Ovary usually 2- (incompletely 4-) celled. Styles 2. Otherwise like *Amelanchier*.

1. PRUNUS, Tourn. PLUM, CHERRY, &c.

Calyx 5-cleft. Petals 5, spreading. Stamens 15 to 25, inserted with the petals — Leaves simple, usually serrulate: flowers white, fascicled in the axils, or in terminal racemes.

* *Flowers in umbel- or corymb-like clusters from lateral scaly buds in early spring, preceding or coëtaneous with the leaves.*

1. **P. Americana.** Marshall. (WILD YELLOW or RED PLUM). Tree thorny, 8 to 20 feet high: leaves ovate, or somewhat obovate, conspicuously pointed, coarsely or doubly serrate, very veiny, glabrous when mature: fruit nearly destitute of bloom, roundish oval, yellow, orange, or red; the stone turgid, more or less acute on both margins: pleasant-tasted, but with a tough and sour skin. — Colorado. Very common throughout the East.

2. **P. Chicasa,** Michx. (CHICKASAW PLUM.) Stem scarcely thorny: leaves nearly lanceolate, finely serrulate, glabrous: fruit nearly destitute of bloom, globular, red; the stone ovoid, almost as thick as wide, rounded at both sutures, one of them minutely grooved. — Perhaps native only west of the Mississippi from Arkansas southward, but introduced eastward, and westward to Colorado.

3. **P. Pennsylvanica**, L. (WILD RED CHERRY.) Tree 20 to 30 feet high, with light red-brown bark: leaves oblong-lanceolate, pointed, finely and sharply serrate, shining, green and smooth both sides: fruit globose, light red, very small, with thin and sour flesh; stone globular. — From Colorado northward, and eastward to Newfoundland and Virginia.

4. **P. emarginata**, Walpers, var. **mollis**, Brewer. Becoming a small tree 25 feet high, with bark like that of an ordinary Cherry-tree, more or less woolly-pubescent: leaves oblong-ovate to lanceolate, mostly obtuse, crenately serrulate, narrowed to a short petiole, with usually one or more glands near the base of the blade, more or less woolly-pubescent on the under side: fruit globose, black, bitter and astringent; stone with a thick grooved ridge upon one side. — Bot. Calif. i. 167. Bitter Root Mountains and westward into Oregon and California.

* * Flowers in racemes terminating leafy branches, hence appearing after the leaves, late in spring.

5. **P. demissa**, Walpers. (WILD CHERRY.) An erect slender shrub 2 to 12 feet high: leaves ovate or oblong-ovate, abruptly acuminate, mostly rounded or somewhat cordate at base, sharply serrate, usually more or less pubescent beneath, with 1 or 2 glands at base: fruit purplish-black, or red, sweet and edible, but somewhat astringent; stone globose. — From the Rocky Mountains westward to the coast.

6. **P. Virginiana**, L. (CHOKe CHERRY.) Leaves rarely at all pubescent, more frequently somewhat cuneate at base: fruit dark red, very astringent and scarcely edible; the stone more ovoid and acutish: otherwise like the last, but more diffuse in habit, and preferring stream banks and moist localities. — This species appears to be distributed throughout the whole of North America except in the region west of the Rocky Mountains.

2. SPIRÆA, L. MEADOW-SWEET.

Petals 5, rounded, nearly sessile. Stamens numerous. Carpels usually 5 or more. — Perennial herbs or mostly shrubs: flowers white or rose-colored, in compound corymbs or spikes. — We follow the arrangement of Dr. Maximowicz in recognizing the four following genera as distinct from *Spiræa*. Bot. Calif. ii. 443.

* Erect shrubs: petals rose-colored or purplish: flowers in compound corymbs.

1. **S. betulifolia**, Pallas. Glabrous or finely pubescent, with reddish bark: leaves broadly ovate to ovate-oblong, acutely and unequally serrate or incised, on short petioles or nearly sessile: flowers pale purple, the fastigate corymbs often leafy-bracted: ovules 5 to 8. — *S. corymbosa*, Raf. Headwaters of the Missouri, eastward in the Alleghany Mountains, westward to N. California, and northward to Alaska.

Var. **rosea**, Gray. Corolla rose-red. — Proc. Am. Acad. viii. 381. W. Wyoming, Idaho, and westward to Oregon and California.

* * Low herbaceous perennials, woody at base: petals white: flowers in dense cylindrical spikes on scape-like stems.

2. **S. cæspitosa**, Nutt. Cespitose, on rocks: leaves rosulate on the short tufted branches of the woody spreading rootstock, oblanceolate or linear-

spatulate, silky on both sides; those of the scape scattered and narrower calyx-lobes silky: filaments and styles exserted: carpels 3 to 8, somewhat villous or glabrous, 2-seeded. — Torr. & Gray, Fl. i. 418. W. Wyoming to Montana and Oregon, and southward to New Mexico.

3. ARUNCUS, L. GOAT'S-BEARD.

Herbaceous: the small white flowers in numerous filiform paniced spikes.

1. **A. sylvester**, Kost. Smooth, branching, 3 to 5 feet high: leaves large; leaflets thin, sparingly villous beneath, ovate to lanceolate, acuminate, sharply and laciniately doubly toothed, the terminal one broadest: panicle large and compound, pubescent: filaments long-exserted: carpels 3 to 5, smooth. — *Spiræa Aruncus*, L. Ranges across the continent.

4. PHYSOCARPUS, Maxim. NINE-BARK.

Carpels 1 to 5, divergent. Ovules 2 to several. — Diffuse shrubs: flowers large, white.

1. **P. opulifolia**, Maxim. A shrub 3 to 10 feet high, with ash-colored shreddy bark: leaves ovate or often cordate, 3-lobed and toothed, on slender petioles, *nearly glabrous: flowers on long slender pedicels* in simple umbel-like hemispherical tomentose corymbs: carpels 2 to 5, *glabrous*. — *Spiræa opulifolia*, L. *Neillia opulifolia*, Benth. & Hook. From California northward to British America and eastward across the continent.

2. **P. Torreyi**, Maxim. A small shrub, differing from the last in its *smaller leaves*, its *finer pubescence*, and the *leaves sometimes densely white-tomentose beneath*, its *fewer and smaller flowers on short pedicels*, fewer stamens, and especially the *densely tomentose ovaries*, which are fewer (1 or 2) and become less inflated. — *Spiræa opulifolia*, var. *pauciflora*, Hook., and in Fl. Colorado var. *parvifolia*. *Neillia Torreyi*, Watson. In the mountains of Colorado and westward to Nevada.

5. CHAMÆBATIARIA, Maxim.

Flowers large, white, in a leafy terminal racemose panicle. — A stout, diffusely branched, glandular-pubescent shrub.

1. **C. Millefolium**, Maxim. More or less tomentose: leaves narrowly lanceolate in outline, scattered or fascicled at the ends of the branches, with very numerous (about 20) pinnæ and minute oblong obtuse leaflets (about 6 pairs): the erect acute lobes of the calyx nearly equalling the orbicular petals: carpels 5, pubescent. — *Spiræa Millefolium*, Torr. Pac. R. Rep. iv. 83, t. 5. From W. Wyoming (Coulter) to California.

6. HOLODISCUS, Maxim.

Petals white, broadly oblong, about equalling the 5-parted calyx. — A diffuse shrub, with grayish brown bark: flowers in loose spreading panicles.

1. **H. discolor**, Maxim. Pubescent, 4 feet high or more: leaves broadly ovate, truncate at base or cuneate into a slender petiole, more or less silky-

tomentose beneath, nearly smooth above, pinnatifidly toothed or lobed, the lobes often dentate: panicle much branched, tomentose. — *Spiræa discolor*, Pursh.

Var. **dumosa**, Maxim. Only 1 to 3 feet high: leaves usually small, cuneate into a short margined petiole, often white tomentose beneath: panicle mostly smaller and less diffuse. — *Spiræa dumosa*, Nutt. *S. discolor*, var. *dumosa*, Watson. Colorado and New Mexico and thence to the Sierra Nevada and Oregon.

7. RUBUS, L. RASPBERRY. BLACKBERRY.

Petals 5, conspicuous. Styles nearly terminal. — Erect or trailing, often prickly: leaves simple or pinnately 3 to 7-foliolate: flowers white or reddish, in panicles or corymbs, or solitary: fruit usually edible, red, purple, or purplish-black. — Ours are all true Raspberries, having fruit with a bloom separating from the receptacle when ripe. The Blackberries, having fruit black, shining and persistent on the receptacle, are not known to occur within our range.

* *Leaves simple: prickles none (except in No. 3): flowers large: fruit and receptacle flat and broad.*

1. **R. Nutkanus**, Moçino. (SALMON-BERRY.) Stems 3 to 8 feet high; bark green and smooth or more or less glandular-pubescent, becoming brown and shreddy: leaves palmately and nearly equally 5-lobed, cordate at base, unequally serrate, 4 to 12 inches broad, glabrous or somewhat tomentose, the veins beneath as well as the petioles and peduncles usually more or less hispid with gland-tipped hairs: flowers white, an inch or two broad: calyx densely tomentose: carpels very numerous, tomentose: fruit red, large, and pleasantly flavored. — From Colorado northward, westward to the coast, and eastward to Upper Michigan.

2. **R. deliciosus**, James. Shrub 3 to 4 feet high; branches, young leaves, and calyx tomentose-pubescent or puberulent, not glandular: leaves reniform-obicular, rugose, more or less 3 to 5-lobed, finely serrate-toothed: flowers 2 inches across: sepals with a dilated acumination: petals white: fruit purplish, large, smooth, "flavor not agreeable to the human palate." — Cañons of Colorado.

3. **R. nivalis**, Dougl. — Low, not more than 6 inches high, frutescent: leaves cordate, 3-lobed, sharply toothed, glabrous, the petioles and veins of the leaves armed with recurved prickles: peduncles short, 2-flowered: petals red (?): fruit red. — In the Bitter Root Mountains and northward. Probably a species of the next section with the leaflets confluent.

* * *Leaflets 3 to 5: petals small, erect, white.*

+ *Stems annual, herbaceous, not prickly: fruit of few separate grains.*

4. **R. triflorus**, Richardson. Stems ascending or trailing: leaflets 3 (or pedately 5), rhombic-ovate or ovate-lanceolate, acute at both ends, coarsely doubly serrate, thin, smooth: peduncle 1 to 3-flowered: fruit small, red. — Colorado and northward into British America and eastward to the New England and Middle States.

+ + *Stems biennial and woody, prickly: receptacle oblong: fruit hemispherical.*

5. **R. strigosus**, Michx. (WILD RED RASPBERRY.) Stems upright, and with the stalks, etc. beset with stiff straight bristles, glandular when young,

somewhat glaucous: leaflets oblong-ovate, *cut-serrate*, whitish-downy underneath, the lateral ones sessile: petals as long as the sepals: fruit light red. — From New Mexico and Colorado northward to British America and thence eastward to the New England and Middle States; also in Nevada.

6. **R. occidentalis**, L. (BLACK RASPBERRY. THIMBLEBERRY.) *Glaucous all over: stems recurved, armed like the stalks, etc. with hooked prickles, not bristly: leaflets 3, ovate, coarsely doubly serrate, whitened-downy underneath, the lateral ones somewhat stalked: petals shorter than the sepals: fruit purple-black.* — From Oregon eastward to Missouri and thence throughout the Eastern States, especially to the north.

8. PURSHIA, DC.

Calyx funnel-shaped. Petals exceeding the calyx-lobes, yellow. Stamens about 25, in one row. Carpels sometimes 2, narrowly oblong. Fruit pubescent, attenuate at each end, exserted. — Diffusely branched: leaves mostly fascicled, cuneate: flowers terminal on the short branchlets.

1. **P. tridentata**, DC. Usually 2 to 5 (rarely 8 or 10) feet high, with brown or grayish bark; the young branches and numerous short branchlets pubescent: leaves cuneate-obovate, 3-lobed at the apex, petioled, white-tomentose beneath, greener above: calyx tomentose with some glandular hairs: petals spatulate-obovate. — Arizona and New Mexico, and northward throughout the Rocky Mountain region to the British boundary; westward to the Sierras.

9. COLEOGYNE, Torr.

Calyx with a membranaceous margin, colored within. Stamens numerous, inserted upon the base of a tubular torus which includes the ovary. Style lateral, very villous at base, twisted, exserted, persistent. Fruit glabrous, included. — Diffusely branched, somewhat spinescent: leaves coriaceous: flowers terminal on the short branchlets, subtended by 1 or 2 pairs of 3-lobed bracts, yellow, showy.

1. **C. ramosissima**, Torr. The short rigid branches opposite and spinescent; bark gray: leaves approximate upon the branchlets, linear-oblancheolate, puberulent with appressed hairs attached by the middle: tube of the torus membranaceous, dilated below and narrowed to the shortly 5-toothed apex, densely white-villous within: akene somewhat compressed, the obtuse apex incurved. — Pl. Frem 8, t. 4. From S. Colorado to Arizona and Nevada, and in California.

10. CERCOCARPUS, HBK. MOUNTAIN MAHOGANY.

Stamens 15 to 25, in 2 or 3 rows on the limb of the calyx. Fruit coriaceous, linear, terete, villous, included in the enlarged calyx-tube. — Leaves evergreen.

1. **C. ledifolius**, Nutt. A shrub or small tree, 6 to 15 feet high: leaves narrowly lanceolate with margins more or less revolute, thick-coriaceous and somewhat resinous, entire, more or less tomentose, but glabrous above, acute:

flowers sessile, tomentose: limb of the calyx deeply toothed: tail of the akene at length 2 or 3 inches long. — Torr. & Gray, Fl. i. 427. W. Wyoming and through the Wasatch to the Sierras and northward.

2. **C. parvifolius**, Nutt. A shrub usually 2 to 10 feet high (sometimes 15 to 20 feet); *leaves cuneate-obovate, less coriaceous, serrate towards the obtuse or rounded summit, more or less silky above, densely hoary-tomentose beneath: flowers on short slender pedicels: limb of the calyx with short teeth: tail of the akene often 4 inches long.* — From New Mexico to Wyoming and westward to the coast.

11. COWANIA, Don. CLIFF ROSE.

Petals obovate, spreading. Stamens numerous, in 2 rows, inserted with the petals at the throat of the calyx-tube. Carpels densely villous. Fruit coriaceous, narrowly oblong, striate, nearly included in the dilated calyx-tube. — Leaves small, toothed or pinnatifid, coriaceous, glandular-dotted.

1. **C. Mexicana**, Don. A much branched shrub, 1 to 6 feet high; the trunk with abundant shreddy light-colored bark: leaves approximate upon the short branchlets, cuneate-obovate in outline, pinnately 3 to 7-lobed, dark green above, tomentose beneath: flowers yellow, the calyx-tube attenuate into a short glandular-hairy pedicel: tail of the akene at length 2 inches long or more. — N. Utah and S. Colorado to Central Mexico.

12. FALLUGIA, Endlicher.

Calyx-tube villous within; the 5 lobes with alternate linear bractlets. Stamens numerous, inserted in a triple row upon the margin of the calyx-tube. Carpels densely villous, inserted upon a small conical receptacle. Fruit coriaceous, narrowly oblong, exserted. — A low undershrub: leaves pinnately lobed, margin revolute: flowers white.

1. **F. paradoxa**, Endlicher. Much branched with somewhat virgate slender branches; epidermis white, persistent: leaves scattered or fascicled, somewhat villous, cuneate and attenuate into a linear base, pinnately 3 to 7-cleft above. — From Colorado to California and southward into Mexico.

13. DRYAS, L.

Calyx open, flattish, 8 to 9-parted. Petals large, white or yellowish. — Dwarf and matted slightly shrubby plants, with simple toothed leaves and solitary large flowers.

1. **D. octopetala**, L. Leaves oblong-ovate, coarsely crenate-toothed, obtuse at each end, clothed with a white tomentum beneath, the veins prominent, the margins revolute: sepals linear. — Alpine. High peaks of Colorado and northward throughout British America to Greenland.

14. GEUM, L. AVENS.

Calyx-lobes usually with 5 alternate bractlets. Carpels on a conical or clavate receptacle. Akenes small, compressed. — Perennial herbs: leaves mostly radical, lyrate or pinnate; stipules adnate to the sheathing petioles: flowers rather large, solitary or corymbose.

§ 1. *Styles jointed and bent near the middle, the upper part deciduous, the lower naked and hooked, becoming elongated: calyx-lobes reflexed. — In ours the petals are golden-yellow, broadly obovate, exceeding the calyx.*

1. **G. macrophyllum**, Willd. *Bristly-hairy, stout (1 to 3 feet high): root-leaves lyrate and interruptedly pinnate, with the terminal leaflet very large and round heart-shaped; lateral leaflets of the stem-leaves 2 to 4, minute, the terminal roundish, 3-cleft, the lobes wedge-form and rounded: receptacle of the fruit nearly naked. — From the Sierra Nevada to the Atlantic, and northward to Sitka.*

2. **G. strictum**, Ait. *Somewhat hairy (3 to 5 feet high): root-leaves interruptedly pinnate, the leaflets wedge-obovate: leaflets of the stem-leaves 3 to 5, rhombic-ovate or oblong, acute: receptacle of fruit downy. — From Colorado northward, and eastward to the Atlantic.*

§ 2. *Style jointed and bent in the middle, the upper joint plumose: flowers large: calyx erect or spreading.*

3. **G. rivale**, L. *Stems nearly simple: root-leaves lyrate and interruptedly pinnate; those of the stem few, 3-foliate or 3-lobed: calyx brown purple: petals dilated-obovate, retuse, contracted into a claw, purplish orange: head of fruit stalked in the calyx. — Colorado, W. Montana, and northward; also eastward to Newfoundland.*

§ 3. *Style not jointed, wholly persistent and straight: head of fruit sessile: flowers large: calyx erect or spreading. — Flowering stems simple and bearing only bracts or small leaves.*

4. **G. triflorum**, Pursh. *Low, softly-hairy: root-leaves interruptedly pinnate; the leaflets very numerous and crowded, oblong wedge-form, deeply cut-toothed: flowers 3 or more on long peduncles: bractlets linear, longer than the purple calyx, as long as the oblong purplish erect petals: styles very long, strongly plumose in fruit. — In the mountains from the Sierra Nevada northward and eastward to Arctic America and Labrador.*

5. **G. Rossii**, Seringe. *Slightly pubescent above: root-leaves interruptedly pinnate, rather glabrous, minutely ciliate: leaflets ovate or cuneiform, 2 to 3-lobed, incised or entire: scape 1-flowered: calyx-lobes shorter than the roundish yellow petals: styles glabrous, not exerted in fruit. — Alpine. High peaks of Colorado and W. Montana, and northward through Arctic America.*

Var. humile, Torr. & Gray. *More pubescent almost silky when young, somewhat larger: leaflets more numerous and crowded: scape sometimes 2-flowered. — Fl. i. 424. Colorado, Nevada, and northward to Oonalaska.*

15. FRAGARIA, Tourn. STRAWBERRY.

Petals 5, white, spreading. Stamens many in one row. — Acaulescent stoloniferous perennials: leaves palmately trifoliate; the leaflets obovate-cuneate, coarsely toothed: flowers few, cymose upon short erect scapes.

1. **F. Virginiana**, Duchesne. *Akenes imbedded in the deeply pitted fruiting receptacle, which usually has a narrow neck: calyx becoming erect after flowering and connivent over the hairy receptacle when sterile or unfructified: leaflets of a firm or coriaceous texture: the hairs of the scape and especially of the pedicels silky and appressed. — The species seems to be confined to the Atlantic States.*

Var. **Illinoensis**, Gray. A coarser or larger plant, perhaps a distinct species: the flowers more inclined to be polygamo-diacious: the villous hairs of the scape and pedicels widely spreading. — The common form in the mountains and extending eastward to the Atlantic States.

Var. **glauca**, Watson. Differs from the type in the perfectly smooth and glaucous surface of the leaf. — Bot. King's Exp. 85. In the Wasatch and Uinta Mountains.

2. **F. vesca**, L. Akenes superficial on the glabrous conical or hemispherical fruiting receptacle (not sunk in pits): calyx remaining spreading or reflexed: hairs on the scape mostly widely spreading, on the pedicels appressed: leaflets thin, even the upper surface strongly marked by the veins. — Throughout the United States and Arctic America.

16. POTENTILLA, L. FIVE-FINGER.

Petals 5, obovate or broadly obovate. Styles lateral or nearly terminal, short, deciduous. Akenes small, turgid, crustaceous. — Herbaceous or rarely woody: flowers cymose, or axillary and solitary. — Watson, Proc. Am. Acad. viii. 549.

* *Styles thickened and glandular toward the base: carpels glabrous, sessile: inflorescence cymose.*

+ *Style attached below the middle of the ovary: disk thickened: stamens 25 to 30: perennial herbs with glandular-villous pubescence and pinnate leaves.*

1. **P. arguta**, Pursh. Stem erect and stout, 1 to 4 feet high, simple below: radical leaves 7 to 11 foliolate; leaflets rounded, ovate, or subrhomboidal, incised or doubly serrate: cyme strict and rather close: calyx densely pubescent: stamens mostly 30. — New Mexico and northward to N. Idaho, thence eastward to the New England States and Canada.

2. **P. glandulosa**, Lindl. Resembling the last, but usually more slender and branched, 1 to 2 feet high, and for the most part less pubescent: leaflets more frequently 5 to 9: cyme panicle, with elongated branches and more slender pedicels: calyx much less tomentose: stamens usually 25. — **P. fissa**, Nutt. In the mountains, from New Mexico and Colorado northward, and thence westward to California and Washington.

+ + *Style terminal: disk not thickened: flowers small: leaves pinnate or ternate.*

++ *Annual or biennial: leaflets incisely serrate, not white-tomentose: stamens 5 to 20.*

3. **P. Norvegica**, L. Erect, stout, $\frac{1}{2}$ to 2 feet high, at length dichotomous above, hirsute: leaves ternate; leaflets obovate or oblong-lanceolate: cyme leafy and rather loose: calyx large: stamens 15, rarely 20: akenes rugose, or nearly smooth: receptacle large, oblong. — Throughout N. America, especially northward.

4. **P. rivalis**, Nutt. More slender, usually diffusely branched: pubescence softly-villous, sometimes nearly wanting: leaves pinnate, with 2 pairs of closely approximate leaflets, or a single pair and the terminal leaf 3-parted; upper leaves ternate; leaflets cuneate-ovate to lanceolate, coarsely serrate: cymes loose, less leafy: calyx small: petals minute: stamens 10 to 20: akenes usually

smooth: receptacle short. — Torr. & Gray, Fl. i. 437. From the Missouri River to the Rocky Mountains.

Var. **millegrana**, Watson. *Leaves all ternate: stems erect or weak and ascending: akenes often small and light-colored.* — Rev. Pot. 553. *P. millegrana*, Engelm. Eastern slope of the Sierras and eastward to New Mexico and the Missouri.

5. **P. supina**, L. Stems decumbent at base or erect: *pubescence scanty, villous, spreading: leaflets pinnately 5 to 11, obovate or oblong: cymes loose, leafy: petals equalling the sepals: stamens 20: akenes strongly gibbous by the thickening of the very short pedicel.* — *P. paradoxa*, Nutt. From the Missouri to New Mexico, and eastward to the Mississippi, Ohio, and the Great Lakes.

++ ++ *Herbaceous perennials, more or less white-tomentose: leaflets incisely-pinnatifid: bractlets and sepals nearly equal: stamens usually 25.*

6. **P. Pennsylvanica**, L. Silky-tomentose: leaflets 5 to 9, *white tomentose beneath, short-pubescent and greener above*, the segments linear, *slightly or not at all revolute: cyme fastigiate but rather open, the pedicels erect.* — From Colorado and New Mexico northward, thence eastward to the New England coast and Canada.

Var. **strigosa**, Pursh. *Smaller: leaflets mostly tomentose on both surfaces, deeply pectinate-divided or pinnatifid, with revolute margins: cyme short and close.* — From Colorado northward, and along the Missouri.

Var. **glabrata**, Watson. *Leaves subglabrous on both sides, the lobes of the leaflets silky-tufted at the apex.* — Rev. Pot. 554. Mountains of Colorado, Nevada, and northward into British America.

* * *Styles filiform, not glandular at base: inflorescence cymose.*

+ *Style terminal: carpels glabrous: disk not thickened: stamens 20: herbaceous perennials, with conspicuous flowers.*

++ *Leaves pinnate (sometimes digitate in Nos. 7 and 11): bractlets shorter than the sepals.*

7. **P. Hippiana**, Lehm. *Densely white-tomentose and silky throughout, the upper surface of the leaves a little darker: stems branching above into a diffuse cyme: leaves occasionally digitate in reduced alpine specimens; leaflets 5 to 11, diminishing uniformly down the petiole, incisely toothed at least towards the apex: carpels 10 to 30.* — From New Mexico and Arizona to Nebraska and the Saskatchewan.

Var. **pulcherrima**, Watson. *Leaflets 5 to 9, approximate, crowded, or digitate, the upper surface green and pubescent or subglabrous.* — Rev. Pot. 555. *P. pulcherrima*, Lehm. In the mountains from New Mexico to British America.

8. **P. effusa**, Dougl. *Tomentose throughout with scattered villous hairs: stems diffusely branched above: leaflets 5 to 11, interruptedly pinnate, the alternate ones often smaller, coarsely incised-serrate or dentate: carpels 10.* — From Colorado northward into British America.

9. **P. crinita**, Gray. *Appressed silky villous, not at all tomentose: stems decumbent: leaflets 9 to 15, mostly folded and fulcrately recurved, coarsely serrate, villous beneath, scarcely so or glabrous above: carpels 25 to 30.* — Pl. Fendl. 41. S. W. Colorado and New Mexico.

10. **P. Plattensis**, Nutt. Subalpine: pubescence appressed silky-villous throughout, scanty or nearly wanting: stems decumbent: leaflets 7 to 13, usually crowded and often alternate, deeply incised-pinnatifid into 3 to 7 linear segments: flowers few, in an open cyme: carpels 25 to 40. — Torr. & Gray, Fl. i. 439. *P. diversifolia*, var. *pinnatisecta* of Bot. King's Exp. 87. Mountains of Colorado and Nevada, and in the Uintas.

11. **P. dissecta**, Pursh. Low, alpine, more or less silky-villous, with somewhat spreading hairs, or nearly glabrous: stems decumbent or ascending: leaflets 5 to 7, or rarely but 3, often glaucous, closely pinnate, or as frequently digitate, the upper one incisely pinnatifid or serrate, the lowest often but trifid: flowers few, in an open cyme: carpels 10 to 20 or more. — *P. diversifolia*, Lehm. From Colorado to California and British America. The following varieties occur with the type.

Var. **glaucophylla**, Lehm. Glaucous-green: leaves digitate, nearly glabrous on both sides.

Var. **multisecta**, Watson. Canescent with a not very dense silky pubescence: leaves digitate or nearly so, the leaflets digitately or pinnately divided and the segments linear. — Bot. King's Exp. 86.

Var. (?) **decurrens**, Watson. Leaflets but 3 or with 1 to 2 additional distant pairs of smaller ones, the terminal leaflet truncately 3-toothed, the upper pair 2 to 3-toothed, conspicuously decurrent: stem 1-flowered, 3 inches high, glabrous throughout, excepting the villous calyx and tufted apices of the leaves. — Rev. Pot. 557. From peaks of the Uintas.

++ ++ Leaves digitately 5 to 7-foliate (rarely pinnate in No. 12): tomentose or villous.

12. **P. gracilis**, Dougl. Villous and more or less tomentose: stems 2 to 3 feet high: leaflets mostly 7, incisely serrate or pinnatifid, tomentose beneath, green above and subvillous or appressed silky: carpels 40 or more. — From New Mexico to Utah and California, and thence northward to the Saskatchewan and Alaska.

Var. **flabelliformis**, Torr. & Gray. Leaflets very deeply pinnatifid. — Fl. i. 440.

Var. **fastigiata**, Watson. Cyme shorter and more compact, more densely pubescent: often low. — Rev. Pot. 557. *P. fastigiata*, Nutt.

Var. **rigida**, Watson. Villous, but without tomentum: usually tall and stout. — Loc. cit. *P. Nuttallii*, Lehm.

13. **P. humifusa**, Nutt. Densely white-tomentose and silky-villous: stems decumbent, 2 to 4 inches long, slender: leaflets 5, green and appressed silky above, only the rounded or truncate apex serrate with 3 to 5 teeth: carpels 15 to 20. — From the mountains of Colorado to the Saskatchewan.

++ ++ ++ Leaves ternate: low, arctic or alpine, few-flowered.

14. **P. nivea**, L. Pubescence silky-villous, densely white-tomentose on the under side of the leaves: leaflets coarsely incised-serrate or pinnatifid, the terminal one sessile or petiolulate: carpels few or many. — From Colorado northward.

Var. **dissecta**, Watson. Leaves digitately or pinnately 5-foliate, the leaflets deeply pinnatifid: stems 1 to 2 inches high, 1 to 3-flowered. — Rev. Pot. 559. In the Uintas and mountains of Montana and British America.

+ + *Style attached below the middle of the ovary: carpels on short pedicels, and, with the receptacle, densely villous: disk not thickened: more or less woody perennials.*

15. **P. fruticosa**, L. Shrubby, much branched, 1 to 4 feet high: pubescence silky-villous: leaves pinnate; leaflets 5 to 7, crowded, oblong-lanceolate, entire, usually white beneath and the margins revolute. — From Colorado westward to N. California, northward to the Arctic Circle, and eastward to New Jersey and Labrador.

* * * *Styles filiform, attached to the middle of the ovary: peduncles axillary, solitary, 1-flowered: carpels glabrous: stems creeping or decumbent: herbaceous perennials.*

16. **P. Anserina**, L. Spreading by slender many-jointed runners, white-tomentose and silky-villous: leaves all radical, pinnate; leaflets 7 to 21, with smaller ones interposed, sharply serrate, silky-tomentose at least beneath. — From California, New Mexico, Illinois, and Pennsylvania northward to the Arctic Ocean and Greenland.

17. SIBBALDIA, L.

Petals linear-oblong. Styles lateral. — Dwarf and cespitose arctic or alpine perennials: leaves thick; the leaflets few-toothed at the truncate summit: flowers cymose.

1. **S. procumbens**, L. Somewhat villous: stems creeping, leafy at the extremities: leaflets cuneate: peduncles usually shorter than the leaves: akenes on very short hairy stipes. — Mountains of Colorado and California, and the White Mountains, and northward to Alaska and Greenland.

18. IVESIA, Torr. & Gray.

Calyx campanulate. Akenes fixed by the middle. — Herbaceous perennials: flowers in cymes or open panicles.

1. **I. Gordoni**, Torr. & Gray. Viscid-pubescent or often somewhat hirsute, or glabrate: stems 3 to 10 inches high from a thick resinous caudex: leaflets obovate, with oblong or spatulate segments; cauline leaves one or two, pinnatifid. — Pac. R. Rep. vi. 72. Wyoming, Utah, Arizona, and westward to California.

19. CHAMÆRHODOS, Bunge.

Calyx campanulate, deeply 5-cleft; the base lined with a membranous disk, which is very densely bearded at the margin. Stamens opposite the petals, inserted with them into the sinuses of the calyx above the disk. Styles arising near the base of the ovaries. — Small, erect and branching glandular-pubescent herbs: inflorescence dichotomously cymose.

1. **C. erecta**, Bunge. Stem slender, two inches to a foot high, paniculately branched above: radical leaves rosulate, ternately or biternately many-cleft; the upper cauline ones 3 to 5-cleft. — Colorado and northward into British America.

20. **AGRIMONIA**, Tourn. **AGRIMONY.**

Tall perennial herbs: leaves interruptedly pinnate: flowers in slender spike racemes, with 3-cleft bracts: fruit pendulous.

1. **A. Eupatoria**, L. Leaflets 5 to 7, with minute ones intermixed, oblong-obovate, coarsely toothed: petals twice the length of the calyx. — Colorado; common throughout the Eastern States.

21. **POTERIUM**, L. **BURNET.**

Stamens 2 to 4 or more: filaments often elongated. — Ours is an annual: leaflets deeply pinnatifid, petiolulate: flowers small, perfect in ours.

1. **P. annum**, Nutt. Glabrous, slender, 6 to 15 inches high: leaflets 4 to 6 pairs, ovate to oblong, with linear segments: flowers greenish, the heads ovoid or oblong: fruit shorter than the bracts. — From the Upper Missouri southward into the Indian Territory; also in California and Washington.

22. **ROSA**, Tourn. **ROSE.**

Calyx without bractlets. Stamens on the thick margin of the silky disk, which nearly closes the mouth of the calyx. Ovaries several, hairy. — Usually prickly: leaves with mostly serrate leaflets: flowers corymbose or solitary, showy. Watson, Proc. Am. Acad. xx. 324.

* *Sepals connivent and persistent after flowering.*

+ *No infrastipular spines; acicular prickles often present: fruit globose.*

1. **R. blanda**, Ait. Stems 1 to 3 feet high, with usually few prickles or none: stipules dilated, naked and entire, or slightly glandular-toothed; leaflets 5 or 7 (rarely 9), cuneate at base and shortly petiolulate, simply and coarsely toothed, glabrous above, paler and glabrous or more or less pubescent beneath, not resinous: flowers corymbose or solitary: sepals entire, hispid. — *R. fraxinifolia*, Gmelin. Within our range at its northeastern boundary, and extending from thence to Newfoundland.

2. **R. Sayi**, Schwein. Stems 1 or 2 feet high, thickly covered with prickles: stipules dilated, glandular-ciliate and resinous; leaflets 3 to 7, usually sessile and obtuse or subcordate at base, more or less doubly toothed, glabrous or slightly pubescent above, resinous beneath: flowers solitary (rarely 2 or 3): outer sepals with lateral lobes, not hispid — Abundant in the mountains from Colorado to British America, thence eastward to Lake Superior.

3. **R. Arkansana**, Porter. Stems $\frac{1}{2}$ to 6 feet high, more or less densely prickly: stipules narrow, more or less glandular-toothed; leaflets 7 to 11, nearly sessile or often petiolulate, somewhat cuneate at base, simply and coarsely toothed, glabrous or more or less pubescent beneath, usually not resinous: flowers corymbose: outer sepals with one or more lateral lobes, usually not hispid. — Fl. Colorado. 38. *R. blanda*, var. *setigera*, Crepin. Abundant in the mountains from New Mexico and W. Texas to British America, and eastward to the Upper Mississippi.

+ + *Infrastipular spines present, often with scattered prickles: leaflets 5 or 7.*

+ + *Sepals entire.*

4. **R. Nutkana**, Presl. Stems stout, 1 to 4 feet high, armed with stout straight or recurved spines: *stipules dilated, glandular-ciliate; leaflets rounded at base, usually resinous beneath, the teeth more or less glandular-serrulate: flowers solitary (rarely 2 or 3), 2 or 3 inches broad: fruit globose, 6 lines broad.* — From N. Utah (in the Wasatch) and Idaho to Oregon and northward. Unarmed forms and others with slender spines are reported from W. Montana (*Watson*).

5. **R. Fendleri**, Crepin. Stems often tall (6 or 8 feet high, or less), with rather slender straight or recurved spines: *stipules mostly narrow and usually naked; leaflets cuneate at base and often petiolulate, usually glaucous, finely pubescent beneath or glabrous or somewhat resinous, the teeth usually simple: flowers smaller, corymbose or often solitary: fruit globose, 4 lines broad.* — From W. Texas and New Mexico to the Sierra Nevada, and northward into British America.

+ + *Outer sepals laterally lobed.*

6. **R. Woodsii**, Lindl. Stems $\frac{1}{2}$ to 3 feet high, with slender straight or recurved spines: *stipules narrow or dilated, entire; leaflets obtuse or usually cuneate at base, glabrous or pubescent above, villous or pubescent or glabrous beneath, simply toothed or resinous and serrulate-toothed: flowers corymbose or solitary, 1½ to 2 inches broad, on very short naked pedicels: fruit globose, 4 or 5 lines broad.* — From Missouri and Colorado to W. Montana and the Saskatchewan. On the plains and in the valleys.

* * *Sepals spreading after flowering and deciduous: infrastipular spines present.*

7. **R. gymnocarpa**, Nutt. Stem slender and weak, 2 to 10 feet high, with straight slender spines: *stipules narrow, glandular-ciliate; leaflets 5 to 9, glabrous, doubly glandular-toothed, sessile or nearly so: flowers solitary or few: sepals 3 or 4 (rarely 6) lines long, entire, deciduous (with the few distinct styles) from the very contracted top of the naked oblong-obovate to globose fruit.* — In the Pacific States, but extending eastward into N. W. Montana and N. Idaho.

23. CRATÆGUS, L. THORN.

Calyx-tube pitcher-shaped; the limb 5-parted. Petals 5, spreading. Stamens 5 to 20. — Shrubs or small trees: leaves simple, toothed, or lobed: flowers corymbose, mostly white.

1. **C. rivularis**, Nutt. Spines few, short and stout: leaves rather rigid, lanceolate-ovate, simply serrate, only the upper ones of the shoots broader, doubly serrate or rarely slightly incised; with narrow, glandular-incised stipules: calyx-lobes usually glandular: fruit black: nutlets 3 lines long or over, usually strongly ridged on the back. — Torr. & Gray, Fl. i. 464. Mountains of Colorado and Utah, and westward to the Pacific.

C. DOUGLASII, Lindl., with broader, thinner, doubly serrate leaves, broad stipules, and smaller black-purple fruit, is reported from Montana, but probably occurs only west of our range.

C. COCCINEA, L., with bright coral-red fruit, and glabrous throughout, has been reported from S. W. Colorado.

C. TOMENTOSA, L., var. *PUNCTATA*, Gray, with fruit dull red and yellowish with whitish dots, and leaves villous-pubescent when young, has been reported from Weber River Valley, Utah.

The last two species, belonging to the section *ERYTHROCARPA*, are very common east, but their occurrence within our range is so doubtful that for the present they are excluded.

24. PYRUS, L. PEAR, APPLE, &C.

Calyx pitcher-shaped or turbinate; limb 5-cleft. Petals 5, spreading, sessile or unguiculate. Stamens 20. Styles distinct, woolly at base. — Ours is a shrub, with pinnate, serrate, deciduous leaves, and white flowers in flat compound cymes.

1. *P. sambucifolia*, Cham. & Schlecht. A shrub 4 to 8 feet high, nearly glabrous: the leaf-buds and inflorescence usually sparingly villous: leaflets 4 to 6 pairs, oblong, acute: fruit berry-like, red. — From Colorado to California, northward into British America and thence eastward to the Atlantic.

25. AMELANCHIER, Medicus. JUNE-BERRY. SERVICE-BERRY.

Calyx-tube campanulate; the limb 5-parted. Petals 5, oblong, ascending. Stamens 20, short. — Shrubs or small trees: leaves simple, serrate: flowers white, racemose: fruit purplish, edible.

1. *A. alnifolia*, Nutt. A shrub 3 to 8 feet high, glabrous throughout or often more or less woolly-pubescent: leaves broadly ovate or rounded, occasionally oblong-ovate, often somewhat cordate at base, serrate usually only towards the summit: petals narrowly oblong. — *A. Canadensis*, var. *alnifolia*, Torr. & Gray. From the Rocky Mountains to California, and eastward into the Mississippi Valley.

26. PERAPHYLLUM, Nutt.

Flowers solitary or in sessile 2 to 3-flowered corymbs; petals orbicular, spreading.

1. *P. ramosissimum*, Nutt. A shrub 2 to 6 feet high, very much branched, with grayish bark and short rigid branchlets: leaves narrowly oblanceolate, attenuate into a very short petiole, somewhat silky-pubescent, sparingly denticulate: flowers appearing with the leaves, pale rose-color: styles elongated, tomentose: fruit globose, fleshy and edible. — Torr. & Gray, Fl. i. 474. S. W. Colorado to Utah, California, and Oregon.

ORDER 27. SAXIFRAGACEÆ. (SAXIFRAGE FAMILY.)

Herbs, shrubs, or sometimes small trees, distinguished from most *Rosaceæ* by albuminous seeds and small embryo; usually by definite stamens, not more than twice the number of the calyx-lobes; commonly

by the want of stipules; sometimes by the leaves being opposite; and in most by the partial or complete union of the 2 to 5 carpels into a compound ovary, with either axile or parietal placentæ. Seeds usually indefinitely numerous. Petals and stamens perigynous. Styles inclined to be distinct.

Tribe I. Herbs. Leaves mostly alternate and without distinct stipules. Styles or tips of the carpels distinct and soon divergent. Fruit capsular. — SAXIFRAGÆ.

* Ovary with 2 or rarely more cells and placentæ in the axis, or of as many distinct carpels.

1. **Saxifraga.** Stamens 10 (rarely more). Petals 5. Calyx-tub. mostly free.

2. **Boykinia.** Stamens 5. Petals 5. Calyx-tube adnate to the ovary.

** Ovary 1-celled, with 2 or 3 parietal placentæ alternate with the styles or stigmas; no sterile filaments.

3. **Tellima.** Stamens 10, included. Petals 3 to 7-parted into narrow divisions, conspicuous. Styles 2 or 3, very short.

4. **Tiarella.** Stamens 10, and styles 2, both long, filiform and exserted. Petals entire, inconspicuous and almost filiform. Capsule very unequally 2-valved to the base.

5. **Mitella.** Stamens 5 (in ours), very short. Petals pinnatifid or 3-cleft into capillary divisions. Styles very short. Capsule depressed.

6. **Chrysosplenium.** Stamens 8 or 10, very short. Petals none. Styles 2. Capsule obcordate, flattened.

7. **Heuchera.** Stamens 5, and styles 2, both commonly slender. Petals entire, small, sometimes minute or none. Capsule ovate, 2-beaked, fully half inferior.

*** Ovary 1-celled, with 3 or 4 parietal placentæ directly under as many obtuse sessile stigmas: a cluster of united sterile filaments alternate with the stamens.

8. **Parnassia.** Calyx 5-parted. Petals 5, large. Stamens 5. Flower solitary.

Tribe II. Shrubs. Leaves opposite, simple: no stipules. Fruit capsular. — HYDRANGIÆ.

* Stamens 20 or more: ovary inferior.

9. **Philadelphus.** Ovary 4 to 5-celled. Petals convolute in the bud.

** Stamens 8 or 10: ovary superior or nearly so.

10. **Jamnesia.** Calyx-tube adnate to the base of the 1-celled ovary and incompletely 3 to 5-celled capsule. Petals 5. Styles 3 to 5.

11. **Fendlera.** Calyx-tube half adherent to the 4-celled ovary and capsule. Petals 4. Filaments 2-lobed. Styles 4.

Tribe III. Shrubs. Leaves alternate, simple: stipules adnate to the petiole or wanting. Fruit a berry.

12. **Ribes.** Calyx-tube adnate to the 1-celled ovary: placentæ 2, parietal.

1. SAXIFRAGA, L. SAXIFRAGE.

Calyx 5-lobed or parted, free, or its tube more or less coherent with the lower part of the ovary. Petals entire. Stigmas mostly depressed-capitate or reniform — Either stemless or short-stemmed: petioles commonly sheathing at base: the small flowers in cymes, cymose panicles, or clusters, sometimes solitary.

* *Stem more or less leafy.*

+ *Calyx free from the ovary: leaves opposite.*

1. **S. oppositifolia**, L. Leaves fleshy, ovate, keeled, ciliate, imbricated on the sterile branches: flowers solitary, large: petals purple, obovate, much longer than the 5-cleft calyx. — From the Teton Mountains northward and throughout Arctic America; also found in Vermont.

+ + *Calyx adherent to the ovary below: stem leaves alternate.*

++ *Sepals distinct or coherent at base.*

= *Petals yellow.*

2. **S. Hirculus**, L. *Leaves lanceolate, nerved, not ciliate: pedicels and upper part of the 1 to 6-flowered stem more or less hairy, not glandular: sepals usually ciliate, much shorter than the very large petals.* — From Colorado to the Arctic Sea.

3. **S. flagellaris**, Willd. *Glandular-pubescent, 1 to 5-flowered: stolons from the axils of the radical leaves long and filiform, naked and rooting at the ends: leaves obovate-spatulate, ciliate; the lower much crowded; the upper oblong or linear: flowers large: sepals very glandular.* — From the high mountains of Colorado to the Arctic regions.

4. **S. aizoides**, L. Low, 3 to 5 inches high, in tufts, with few or several corymbose flowers: *leaves linear-lanceolate, entire, fleshy, distantly spinulose-ciliate: petals spotted with orange.* — "Alpine rivulets on the Rocky Mountains" (Drummond), throughout Arctic America, and found in some of the Atlantic States.

5. **S. chrysantha**, Gray. Dwarf, caespitose, shoots creeping: leaves rosulate, imbricated, oblong-ovate, thick, very smooth: stem filiform, few-leaved, slightly glandular-pubescent, 1 to 2 inches high, 1 to 3-flowered: *calyx segments reflexed.* — Proc. Am. Acad. xi. 83. The *S. serpyllifolia* of Fl. Colorado and Hayd. Rep. 1871. High alpine regions of the Colorado Rocky Mountains.

= = *Petals white or cream-color.*

6. **S. cæspitosa**, L. Dwarf (1 to 2 inches high), caespitose: *leaves glandular-pubescent, 3 to 5-cleft, segments broadly linear and obtuse; the upper leaves linear and entire: flowering stems with a few scattered leaves, glandular, 1 to 4-flowered.* — Mountains of Colorado and extending northward to lat. 56°.

7. **S. cernua**, L. Glabrate or glandular-pubescent: *stems granulate at base, weak, 2 to 5 inches high: lower leaves reniform, broadly toothed or lobed; the upper ones bearing little bulbs in their axils: flowers often solitary, terminal, pendulous: petals retuse.* — Mountains of Colorado and northward throughout the Arctic regions.

8. **S. bronchialis**, L. Stems slender, producing short branchlets: *leaves linear, rather coriaceous, finely ciliate, mucronate-pointed, crowded below: flowers corymbose on a long, slender, bracted peduncle: petals marked with numerous purplish spots.* — From Colorado northward to the N. W. Coast.

++ + *Sepals coherent at least to the middle: petals not yellow.*

9. **S. rivularis**, L. Small: stems weak, 3 to 5-flowered: *lower leaves rounded, 3 to 5-lobed, on slender petioles, the upper lanceolate: petals white, ovate.* — Mountains of Colorado and northward; also in the White Mountains.

10. **S. adscendens**, L. Glandular-pubescent: stems 1 to 3 inches high, erect: *leaves cuneate-ovate, 3 to 5-toothed at the apex, the earlier spatulate and entire, radical ones crowded: branchlets 3-flowered: petals pinkish or yellowish white.* — Mountains of Colorado.

11. **S. Jamesii**, Torr. Glandular-puberulent: stems 2 to 6 inches high from a thick caudex, 5 to 10-flowered: *radical leaves reniform-cordate, smoothish, crenately-toothed or lobed; cauline few, the uppermost bract-like, cuneiform:*

raceme compound: *petals purple, orbicular*. — Mountains of Colorado and northward in the Teton Range and the National Park.

+ + + *Calyx wholly adherent*.

12. **S. debilis**, Engelm. Glabrous or very sparingly glandular-pubescent: stems weak, ascending, 2 to 4-flowered, 2 to 4 inches high: radical leaves small, crenately lobed; cauline 3-lobed or entire: petals white or pinkish, ovate, obtuse. — Mountains of Colorado and northward into Wyoming.

* * *Stemless: petals white*.

+ *Calyx free from the ovary, or nearly so: sepals almost distinct, reflexed*.

13. **S. punctata**, L. Villous-pubescent or nearly glabrous: leaves long-petioled, reniform or orbicular, equally and deeply dentate: scape slender, naked, 1 to 1½ feet high, the peduncles and pedicels of the usually open panicle glandular: petals oval or orbicular. — Colorado, Utah, and northward into British America.

14. **S. stellaris**, L., var. **comosa**, Poir. Leaves wedge-shaped, more or less toothed: scape 4 to 5 inches high, bearing a small contracted panicle: many or most of the flowers changed into little tufts of green leaves: petals unequal, lanceolate and tapering into the claw. — Mt. Evans, Colorado (Greene); also in Maine and far northward.

+ + *Calyx adherent to the ovary at base*.

+ + *Sepals erect*.

15. **S. nivalis**, L. Leaves ovate or obovate, attenuate into a broad petiole, unequally crenate-dentate: scape 2 to 5 inches high, capitately or sub-corymbosely several to many-flowered: petals oblong: capsules purple. — Colorado and northward to Arctic America.

16. **S. Virginianensis**, Michx. Like the preceding, but larger and more open: scape a span to a foot high, at length loosely many-flowered in a paniculate cyme: petals obovate. — In the Rocky Mountains and Coast Ranges; also common in the Atlantic States.

+ + *Sepals spreading, or at length reflexed*.

17. **S. integrifolia**, Hook. Leaves from ovate or obovate to lanceolate-spatulate, 1 to 5 inches long, denticulate or entire, narrowed at base into a very short and margined petiole: scape 1 to 3 feet high, viscid: flowers in small clusters usually in a narrow thyrsiform panicle: petals obovate or broadly spatulate. — *S. hieracifolia* of Hayd. Rep. for 1871 and 1872. From Colorado northward to the Yellowstone and westward to the Sierras.

2. BOYKINIA, Nutt.

Calyx 5-lobed. Petals entire, the base contracted into a short claw. — Perennial, with creeping rootstocks, leafy simple stems, and paniculate or corymbose cymes of white flowers: the leaves all alternate, round-reniform, palmately lobed and incised or toothed, the teeth with callous-glandular tips, and the petiole mostly with stipule-like dilatations or appendages at base.

1. **B. major**, Gray. Stem 2 or 3 feet high: leaves 4 to 8 inches in diameter, 5 to 9-cleft: petioles abruptly appendaged at base, the lower with scari-

ous, the upper with foliaceous and rounded stipules. — In the Sierras from California to Oregon and extending into the Bitter-Root Mountains.

3. TELLIMA, R. Br.

Calyx campanulate or turbinate, 5-lobed; the base of the tube coherent with the base or lower half of the ovary. — Perennials: with palmately-divided leaves, few on the simple stems; their petioles with stipule-like dilatations at base: flowers in a simple terminal raceme; petals white or pink. In ours the slender or filiform rootstock and sometimes even the few-flowered raceme bear clusters of small grain-like bulblets.

1. **T. parviflora**, Hook. *Roughish-hirsute or scabrous-pubescent, a span to a foot high: divisions of the leaves narrowly cuneate and once or twice 3-cleft: calyx obconical or at length almost clavate: petals deeply 3-cleft into linear or oblong divisions: ovary and capsule fully half-inferior.* — Colorado, Utah, and northward through the Yellowstone region to British America.

2. **T. tenella**, Watson. *Small and slender, 2 to 9 inches high, roughish with a minute glandular pubescence: leaves smaller than the preceding ($\frac{1}{2}$ inch in diameter): calyx campanulate: petals 3 to 5-parted or even irregularly 7-parted into mostly linear divisions: ovary and capsule free except the base.* — Bot. King's Exp. 95. Colorado and the Teton Mountains, thence west to the Sierras.

4. TIARELLA, L.

Calyx 5-parted: the base almost free from the ovary, the lobes more or less colored. — Perennial, low or slender: with palmately lobed or divided alternate leaves, and a terminal raceme or panicle of small white flowers.

1. **T. unifoliata**, Hook. *Somewhat pubescent or hairy: flowering stems a span to a foot or more long: leaves thin, cordate, either rounded or somewhat triangular, 3 to 5-lobed and the lobes crenate-toothed; the radical ones slender-petioled; the cauline mostly one, smaller, and short-petioled, or sometimes 2 or 3 similar to the radical.* — From California to British Columbia and extending into N. W. Montana.

5. MITELLA, Tourn. MITRE-WORT.

Calyx 5-cleft, short, coherent with the base of the ovary. — Low and slender perennials: with round heart-shaped alternate leaves on the rootstock or runners; those on the scape opposite, if any: flowers small, in a simple slender raceme or spike.

1. **M. pentandra**, Hook. *Leaves all radical, cordate, slightly lobed, crenately serrate: calyx adherent nearly to the summit of the ovary: petals pectinate-pinnatifid: stamens opposite the petals: stigmas 2-lobed.* — From Colorado to the Yellowstone and the Bitter Root Mountains.

2. **M. trifida**, Graham. *Leaves as in the last, but dentate: calyx adherent to the middle of the ovary: petals 3 to 5-parted: stamens opposite the calyx-lobes: stigmas entire.* — By mistake in Fl. Colorado this species was described under the name *M. pentandra*. From Colorado to British America, and also in California.

6. **CHRYSOSPLENIUM**, Tourn. GOLDEN SAXIFRAGE.

Calyx-tube coherent with the ovary; the blunt lobes 4 or 5, yellow within. Stamens inserted on a conspicuous disk. — Low and small smooth herbs, with tender succulent leaves, and small corymbose flowers.

1. **C. alternifolium**, L. Flowering stems erect: leaves alternate, reniform-cordate, doubly crenate or somewhat lobed. — Colorado and northward.

7. **HEUCHERA**, L. ALUM-ROOT.

Calyx 5-cleft, bell-shaped. — Perennials: with the round heart-shaped leaves principally from the rootstock; those on the scapes, if any, alternate: petioles with dilated margins or adherent stipules at their base: flowers in small clusters disposed in a prolonged and narrow panicle, greenish or purplish.

* *Stamens and styles exerted.*

1. **H. rubescens**, Torr. Scape usually naked, glabrous or somewhat scabrous, 8 to 15 inches high: leaves nearly glabrous, suborbicular, cordate at base, slightly lobed, crenate-dentate, the teeth ciliate: panicle loosely many-flowered, often somewhat reddish: petals linear, more or less rose-colored or white. — From New Mexico and S. W. Colorado to the mountains of Nevada and the Wasatch.

* * *Stamens and styles included (at least at first).*

+ *Generally hirsute: flowers rather large.*

2. **H. hispida**, Pursh. Scapes 2 to 4 feet high, hispid or hirsute with long spreading hairs, scarcely glandular: leaves rounded, slightly 5 to 9-lobed: panicle very narrow: stamens at first included, but soon exerted, longer than the spatulate petals. — Along the Missouri to the mountains, and northward and eastward.

3. **H. cylindrica**, Dougl. Commonly hirsute and above glandular-pubescent: leaves round-reniform or cordate-ovate, crenately doubly toothed and commonly lobed: scape 10 to 24 inches high: the greenish flowers in a cylindrical spike or thyrsus: petals inconspicuous or none. — National Park, Montana, and westward into Nevada, Oregon, etc.

+ + *Puberulent or glabrous: flowers small.*

+ + *Panicle glomerate, spicate.*

4. **H. bracteata**, Seringe. Small, 3 to 6 inches high: scapes numerous from a thick woody caudex: radical leaves roundish-subcordate, incisely lobed, lobes crenately toothed: petals attenuate, scarcely broader than the filaments: styles and stamens at length exerted. — Mountains of Colorado.

+ + + *Panicle loose, racemose.*

5. **H. Hallii**, Gray. Minutely glandular-puberulent: scapes 4 to 8 inches high, naked or with 1 to 3 minute subulate bracts: petals narrowly spatulate, obtuse, exert. — Colorado.

6. **H. parvifolia**, Nutt. Scabrous-puberulent: scape naked, 6 inches to 2 feet high: leaves roundish-cordate, crenately 5 to 7-lobed: petals minute, caducous: seeds muricate or hispid under a lens. — Torr. & Gray, Fl. i. 581. From New Mexico northward through Montana.

8. **PARNASSIA**, Tourn. GRASS OF PARNASSUS.

Perennial smooth herbs, with the leaves entire and chiefly radical, and the large solitary flowers terminating the long naked stems. Petals white, with greenish or yellowish veins.

* *Petals sessile, entire.*

1. **P. parviflora**, DC. *Leaves ovate or oblong, tapering at the base: petals little longer than the calyx: sterile filaments about 5 in each set.*—Along streams in the mountains and eastward to Lake Michigan.

2. **P. palustris**, L. *Leaves heart-shaped: flower nearly an inch broad: petals rather longer than the calyx, few-veined: sterile filaments 9 to 15 in each set.*—Montana and Wyoming, eastward to Lake Superior, and throughout British America.

* * *Petals contracted into a short claw, fringed.*

3. **P. fimbriata**, Banks. *Leaves from reniform to cordate-ovate: the margin of the petals fringed below the middle or towards the base: sterile filaments 5 to 9 in each set and united below into a fleshy carinate scale, or sometimes a dilated scale destitute of bristle-like filaments.*—From Colorado to California and northward to British America.

9. **PHILADELPHUS**, L. SYRINGA. MOCK ORANGE.

Calyx-limb 4 to 5-parted. Petals rounded or obovate, large. Styles 3 to 5, united below or nearly to the top. Seeds with a loose membranaceous coat prolonged at both ends.—In ours the leaves are entire, and the showy white flowers 1 to 3, terminal.

1. **P. microphyllus**, Gray. *Branches slender, erect: leaves small, 6 to 9 lines long, ovate-lanceolate or oblong, shining above, pale and minutely pilose beneath, narrowed at base into a very short petiole: calyx 4-cleft, glabrous without, tomentulose within: styles united to the apex.*—Pl. Fendl. 54. S. Colorado and southward.

10. **JAMESIA**, Torr. & Gray.

Calyx-lobes sometimes bifid. Petals 5, obovate. Alternate stamens shorter; filaments linear, flattened acuminate. Capsule included. Seeds striate-reticulate.—Low, diffusely branching, 2 to 3 feet high: leaves ovate, mucronately serrate, canescent beneath, as well as the petioles, calyx, and branchlets, with a soft hairy pubescence: flowers cymose, in terminal panicles.

1. **J. Americana**, Torr. & Gray. *Cymes often longer than the leaves, 5 to 10-flowered: petals white, glabrous or softly hairy within: calyx-lobes shorter than the petals, enlarged and foliaceous in fruit.*—Fl. i. 593. Utah, Colorado, and New Mexico.

11. **FENDLERA**, Eng. & Gray.

Calyx-tube 8-ribbed. Petals ovate-deltoid, unguiculate, emarginate. Stamens 8: filaments 2-forked at the apex, the lobes divaricate and extended beyond the cuspidate anther. Capsule crustaceous. Seeds reticulate, winged below.—Erect shrub.

1. **F. rupicola**, Eng. & Gray. Pubescent or glabrate, branches terete, striate: leaves deciduous, sessile, oblong, very entire, 3-nerved at base: flowers 1 to 3, terminal on the short branchlets, peduncled, white. — Pl. Wright i. 77. S. W. Colorado and southward.

12. RIBES, L. CURRANT. GOOSEBERRY.

Calyx 5-lobed, often colored. Petals 5, small. Styles 2, distinct or united. Berry crowned with the shrivelled remains of the calyx. — Low, sometimes prickly, with palmately-lobed leaves, often clustered in the axils; the small flowers from the same clusters, or from separate lateral buds.

§ 1. *Mostly thorny under the fascicles, and sometimes scattered-prickly or bristly along the branches: leaves plaited in the bud: calyx mostly recurved or reflexed at flowering-time.* — GOOSEBERRY.

* *Calyx-tube campanulate to cylindraceous: peduncle 1 to 4-flowered.*

+ *Flowers yellow or yellowish: leaves seldom $\frac{1}{2}$ inch in diameter: anthers oval-oblong.*

1. **R. leptanthum**, Gray. Much branched and rigid, 1 to 4 feet high, with comparatively large single or triple thorns: leaves roundish, 3 to 5-cleft, and the lobes crenately-incised or toothed: peduncles very short, 1 to 2-flowered: berry glabrous. — Pl. Fendl. 53. New Mexico, Colorado, and in the Sierras.

+ + *Flowers greenish, white, or dull purplish: leaves mostly an inch or two in diameter: anthers shorter, mostly didymous.*

++ *Ovary and berry unarmed and glabrous: berry pleasant.*

2. **R. divaricatum**, Dougl., var. **irriguum**, Gray. Nearly glabrous or soft-pubescent: stems 5 to 12 feet high, with widely spreading branches; the thorns single or triple: leaves nervose-veiny at base, 3 to 5-lobed, the lobes incisely toothed: the 2 to 4-flowered peduncle and pedicels slender, drooping: calyx livid purplish or greenish white: petals fan-shaped, white: berry dark purple. — *R. irriguum*, Dougl. From Colorado and Idaho to Nevada and Oregon.

3. **R. oxyacanthoides**, L. Mostly glabrous, 2 to 4 feet high; thorns single or triple, small: leaves usually deeply 5-lobed, the lobes incised and coarsely toothed: the 2 to 3-flowered peduncles very short: calyx greenish-white or flesh-colored: stamens and 2-cleft style scarcely longer than the bell-shaped calyx: berry small, purple. — *R. hirtellum*, Michx. From Colorado northward throughout British America; also in California and the N. Atlantic States.

4. **R. rotundifolium**, Michx. Leaves smooth or downy: peduncles slender, 1 to 3-flowered: stamens and 2-parted style slender, longer than the narrow cylindrical calyx: fruit smooth. — The Upper Missouri, and extending eastward to the Atlantic States.

++ ++ *Berry armed with long prickles like a burr, or rarely smooth.*

5. **R. Cynosbati**, L. Spines small or obsolete: leaves pubescent: stamens and undivided style not longer than the broad calyx: berry large. — Near the sources of the Platte, and thence through the N. Atlantic States to Canada.

* * *Calyx-tube saucer-shaped, expanding immediately above the ovary: peduncles racemously 5 to 15-flowered: anthers very short, pointless: berry small and currant-like, beset with some scattered gland-tipped bristles.*

6. **R. lacustre**, Poir. Young stems clothed with bristly prickles, and with weak thorns: leaves heart-shaped, 3 to 5-parted, with the lobes deeply cut. — From California and the Rocky Mountains to the N. Atlantic States and Labrador.

Var. **parvulum**, Gray. Smaller and nearly glabrous. — The commoner western form.

§ 2. *Thornless and prickless: leaves plaited in the bud: berry unarmed (except in No. 7). — CURRANT.*

* *Calyx dilated immediately above the ovary, rotate or saucer-shaped, 5-parted.*

7. **R. prostratum**, L'Her. Stems reclined: leaves deeply heart-shaped, 5 to 7-lobed, smooth; the lobes ovate, acute, doubly serrate: racemes erect, slender, flowers greenish: pedicels and the pale red fruit glandular bristly. — From Colorado northward throughout British America, and in the Atlantic States.

8. **R. Hudsonianum**, Richards. Resembles the last, but the flowers are white and crowded in the erect raceme, and the berry is darker and smooth. — The *R. bracteatum* of King's and Hayden's Reports, not of Douglas. Montana, Wyoming, and thence through British America to Hudson Bay.

9. **R. cereum**, Dougl. Minutely pubescent, usually resinous dotted and more or less glutinous, sometimes glabrous: leaves rounded or reniform, obscurely or more decidedly 3-lobed, crenately toothed or incised: racemes drooping: pedicels hardly any or shorter than the bract: calyx waxy-white, sometimes greenish or pinkish: berry reddish, sweetish. — From New Mexico to Washington and the Dakotas.

Var. **pedicellare**, Gray. Pedicels slender and longer than the bract. — Montana.

* * *Calyx prolonged above the ovary into a campanulate or cylindrical tube: fruit and foliage more or less glandular: bracts conspicuous.*

+ *Flowers dull white or greenish, or sometimes purplish-tinged: racemes somewhat corymb-like and few-flowered: berry black, smooth.*

10. **R. viscosissimum**, Pursh. Pubescent and viscid-glandular: leaves cordate-rounded: racemes ascending; bracts rather shorter than the pedicels. — Idaho and Montana; also in California.

11. **R. floridum**, L. Leaves sprinkled with resinous dots, slightly heart-shaped, sharply 3 to 5-lobed: racemes drooping, downy: bracts longer than the pedicels. — On the Platte in Colorado, and common in the Atlantic States.

+ + *Flowers rose-red, or varying to white: racemes drooping, many-flowered: berry blackish, somewhat hispid-glandular, tough and not juicy.*

12. **R. sanguineum**, Pursh. Two to twelve feet high, varying from nearly glabrous to tomentose-canescens, either almost glandless or glandular: leaves rounded-cordate.

Var. **variegatum**, Watson. Low, nearly glabrous: raceme short and dense, ascending, barely glandular: calyx rose-color: petals white. — *R. Wolfei*, Rothrock. Mountains of Colorado; also in California.

§ 3. *Thornless and prickless : leaves convolute in the bud : calyx-tube elongated : berry naked and glabrous.*

13. **R. aureum**, Pursh. Five to twelve feet high, glabrous or almost so, glandless : leaves 3 to 5-lobed : racemes short, 5 to 10-flowered, with mostly foliaceous bracts : flowers golden-yellow, spicy-fragrant : tube of the salverform calyx 3 or 4 times longer than the lobes : berry yellowish turning blackish. — Colorado and northward, westward to the Pacific coast ; also common in cultivation throughout the Atlantic States. Known as the Buffalo or Missouri Currant.

ORDER 28. CRASSULACEÆ. (ORPINE FAMILY.)

Succulent or fleshy plants, mostly herbaceous, and not stipulate, with completely symmetrical as well as regular flowers, with all the parts distinct, the carpels becoming follicles in fruit.

1. **Tillæa**. Parts of the flower each 3 to 5 : the stamens only as many. Small annuals, with opposite leaves and minute axillary flowers.
2. **Sedum**. Parts of the flower each 4 to 7 : stamens twice as many. Low annual or perennial herbs, with cymose conspicuous flowers.

1. TILLÆA, L.

Seeds longitudinally striate. — Glabrous : leaves entire : flowers white or reddish.

1. **T. Drummondii**, Torr. & Gray. Stems diffuse, *dichotomous*, about an inch high : leaves *oblong-linear*, somewhat connate : flowers on pedicels at length as long as the leaves : carpels 12 to 20-seeded. — Fl. i. 558. S. W. Colorado to Texas and Louisiana.

2. **T. angustifolia**, Nutt. Stems decumbent, rooting at base, diffusely branched, an inch long : leaves *linear*, connate, a line or two long : flowers sessile or on very short pedicels : carpels 8 to 12-seeded. — Torr. & Gray, Fl. i. 558. From Colorado to Oregon.

2. SEDUM, L. STONE-CROP.

Sepals united at base. — Flowers rarely diœcious, in cymes, often secund.

* Flowers mostly diœcious, in a regular compact compound cyme, deep purple or becoming so : leaves serrate, flat.

1. **S. Rhodiola**, DC. Stems 1 to 10 inches high, from a thick fragrant root, leafy : leaves alternate, oblong-oblanccolate : cyme sessile : flowers on short naked pedicels, usually 4-merous. — From Colorado northward to the Arctic coast, and eastward across the continent.

* * Flowers perfect, in a simple terminal cyme, rose-color or nearly white : leaves entire, flat.

2. **S. rhodanthum**, Gray. Stems a half to a foot high, from a thick root : leaves scattered, oblong or oblanccolate : flowers large, mostly 4-merous. — Mountains of Colorado, Utah, and Montana.

* * * *Flowers perfect, secund upon the branches of a forked cyme, mostly yellow or yellowish: leaves very fleshy, entire.*

+ *Leaves narrowed toward the base, obtuse.*

3. **S. debile**, Watson. Stems weak, 2 to 4 inches high, from very slender running rootstocks: leaves rounded or obovate: flowers on rather long pedicels, in small cymes. — Bot. King's Exp. 102. In the Wasatch and Uintas; also mountains of Nevada and N. California.

+ + *Leaves broadest at base, acute.*

4. **S. stenopetalum**, Pursh. Stems 3 to 6 inches high, simple or sometimes branched: leaves narrowly lanceolate: *flowers bright yellow, nearly sessile.* — Torr. & Gray, Fl. i. 560. Very common on both sides of the mountains from Colorado to Montana and into Oregon.

5. **S. Douglasii**, Hook. Stems 3 to 4 inches high, branching at base, from a stout proliferous rootstock: leaves lanceolate or the lowermost linear-subulate, membranaceous when dry: flowers sometimes polygamous, *sessile: follicles at length divaricately spreading from their united bases.* — National Park, W. Montana, Oregon, and California.

ORDER 29. HALORAGÆ. (WATER-MILFOIL FAMILY.)

Aquatic herbs, with inconspicuous and often apetalous flowers sessile in the axil of leaves or bracts, calyx adnate to the ovary in fertile ones, the fruit indehiscent and nut-like.

1. **Hippuris**. Leaves linear, in whorls of 8 or 12. Flowers perfect. Calyx entire. Petals none. Stamen and cell of the ovary one.
2. **Myriophyllum**. Immersed leaves pinnately dissected. Flowers monœcious or polygamous. Parts of the flower in fours.

1. HIPPURIS, L. MARE'S TAIL.

Calyx-tube globular. — Smooth: with erect simple leafy stems: leaves entire: flowers solitary.

1. **H. vulgaris**, L. Stems a foot or two high: leaves usually a half to an inch long, but often much longer, especially the submerged ones: calyx hardly a half-line long. — In shallow ponds throughout the northern part of the continent, and southward in the Rocky Mountains to New Mexico.

2. MYRIOPHYLLUM, L. WATER-MILFOIL.

Limb of the calyx 4-lobed in the sterile flowers, wanting or minutely toothed in the others. Petals 2 to 4, minute or wanting in the pistillate flowers. Stamens 8 (in ours). Ovary 4-celled: stigmas recurved and plumose. — Smooth leafy herbs: leaves whorled in threes or fours: upper flowers usually staminate, the lower pistillate, and the intermediate ones perfect.

1. **M. spicatum**, L. Leaves all pinnately parted and capillary, *except the floral ones or bracts; these ovate, entire or toothed, and chiefly shorter than the flowers*, which thus form an interrupted spike. — In the Atlantic States and across the continent.

2. **M. verticillatum**, L. Like the last, but *floral leaves much longer than the flowers and pectinate pinnatifid*.—Snake River (Coulter); in the Atlantic States and northward.

ORDER 30. **LYTHRACEÆ.** (LOOSESTRIFE FAMILY.)

Herbs with simple and entire leaves, calyx tubular or campanulate and free from the ovary and capsule, but enclosing it, the petals and definite stamens borne in its throat, a single style, and numerous small seeds on a central placenta. Distinguished from *Haloragacæ* and *Onagraceæ* by the free ovary, and from the former also by the numerous seeds.

1. **Ammannia**. Calyx barely 4-angled, short. Petals 4 or none. Stamens 4 or 8. Capsule globular, bursting irregularly. Leaves opposite.
2. **Lythrum**. Calyx striate, cylindrical. Petals commonly 6 (4 to 7). Stamens as many or twice as many. Capsule oblong or cylindraceous.

1. **AMMANNIA**, Houston.

Calyx 4-toothed, with as many intermediate small tooth-like processes. Petals as many, small and fugacious, or none. — Low and smooth annuals, with 4-angled stems, sessile leaves, and small axillary flowers.

1. **A. latifolia**, L. Stems erect: leaves linear-lanceolate, with a broad auricled base: flowers 1 to 5 in each axil, mostly closely sessile. — Milk River, N. Montana; also in Nevada, California, and the S. Atlantic States.

2. **LYTHRUM**, L. LOOSESTRIFE.

Calyx 4 to 7-toothed, with intermediate tooth-like processes. Petals oblong-ovate, often conspicuous. — Erect slender herbs, with angled stems, and axillary mostly solitary flowers.

1. **L. alatum**, Pursh. Tall and wand-like perennial, smooth: branches with margined angles: leaves from oblong-ovate to lanceolate, the upper scattered, not longer than the flowers, which are small and nearly sessile in the axils: proper calyx-teeth often shorter than the intermediate processes: petals purple. — From Colorado to the N. Atlantic States, and southward.

ORDER 31. **ONAGRACEÆ.** (EVENING-PRIMROSE FAMILY.)

Herbs, with perfect symmetrical flowers, the parts being most commonly in fours, the calyx-tube adnate to the ovary and its lobes often colored, the petals borne on its throat or at the sinuses, the cells of the ovary usually of the same number, the stamens as many or twice as many, and styles always single. Leaves simple, but sometimes lobed or divided, either alternate or opposite: no stipules. Flowers often showy. In ours the limb of the calyx is deciduous.

* Capsule loculicidal, many-seeded (the cells rarely only several-seeded). Parts of the flower in fours.

+ Seeds comose at the apex : lower leaves often opposite : stamens 8.

1. **Zauschneria**. Calyx-tube continued much beyond the ovary, funnel-form.

2. **Epilobium**. Calyx 4-parted nearly down to the ovary, or with a short and campanulate tube beyond it.

+ + Seeds not comose : leaves all alternate.

++ Anthers attached near the middle and versatile : petals generally yellow or white or sometimes changing to rose-color.

3. **Gayophytum**. Calyx-tube not produced beyond the ovary ; this and the membranous capsule only 2-celled. The stamens opposite the petals usually sterile.

4. **Oenothera**. Calyx-tube produced beyond the ovary into a linear or obconical tube. Anthers all uniform. Petals without claws.

++ ++ Anthers attached at or near the base, remaining erect ; those opposite the petals much shorter, or sterile, or rarely wanting : petals never yellow.

5. **Clarkia**. Calyx-tube above the ovary obconical ; its lobes reflexed. Petals with claws, either lobed or entire. Capsule coriaceous.

* * Fruit dry and indehiscent, 1 to 4-seeded. Parts of the flower in fours, or rarely threes. In ours the stamens are 8, and the anthers are attached by the middle.

6. **Stenosiphon**. Alternate stamens a little shorter. Ovary 1-celled. Leaves scattered.

7. **Gaura**. Stamens nearly equal : filaments with a scale-like appendage on the inside next the base. Ovary 4-celled. Leaves alternate.

* * * Fruit indehiscent, bur-like, 1 to 2-seeded. Parts of the flower in twos throughout

8. **Circæa**. Leaves opposite.

1. ZAUSCHNERIA, Presl.

Calyx-tube deeply colored above the ovary, with a small globose base and 4-lobed limb, appendaged with 8 small scales, 4 erect and 4 deflexed. Petals obcordate or 2-cleft, scarlet. Stamens exserted. Style long and exserted. Capsule linear, obtusely 4-angled. — Low decumbent perennial, somewhat woody at base : leaves sessile : the large scarlet Fuchsia-like flowers in a loose spike.

1. **Z. Californica**, Presl. More or less villous and often tomentose : leaves narrowly lanceolate to ovate, entire or denticulate : capsule attenuate to the slender base, sometimes shortly pedicellate. — From New Mexico to the Wasatch and N. W. Wyoming, and thence to California.

2. EPILOBIUM, L. WILLOW-HERB.

The alternate stamens shorter : anthers fixed near the middle. Capsule linear, 4-sided. — Perennial or annual : leaves alternate or opposite, nearly sessile, denticulate or entire, often fascicled : flowers rose-color, purple, or white, very rarely yellow.

* *Flowers large : stamens and style declined : stigma-lobes spreading : leaves scattered.*

1. **E. spicatum**, Lam. *Stem erect, simple, often 4 to 7 feet high : leaves lanceolate, sessile, nearly entire, the veins anastomosed near the edge : flowers in a long spicate raceme, bracteate, purplish-lilac : style hairy at the base, at first deflexed.* — *E. angustifolium*, L. Common across the continent.

2. *E. latifolium*, L. Differing from the last in its *short ascending occasionally branched stem*: *ovate-lanceolate*, somewhat pubescent, rather thick and rigid leaves, veins not apparent: *very large axillary and terminal flowers* on short pedicels: somewhat erect *glabrous style*. — Mountains of Colorado to Arctic America.

* * *Flowers small, white: stamens and style erect, the latter much exerted: stigma thick, with 4 spreading lobes: leaves opposite.*

3. *E. suffruticosum*, Nutt. Stems decumbent, much branched: leaves linear-lanceolate, entire, somewhat canescent: flowers axillary near the ends of the branches: capsule clavate, narrowed at each end, on a very short pedicel. — Torr. & Gray, Fl. i. 488. Wasatch Mountains near Ogden, Utah, and northwestward to Oregon and Washington.

* * * *Flowers small: stamens and style erect, the latter included: stigma clavate or cylindrical: lower leaves commonly opposite, the upper often alternate.*

+ *Herbaceous perennials.*

4. *E. alpinum*, L. Low, 2 to 6 inches high, nearly glabrous: stems ascending from a stoloniferous base, simple: leaves elliptical or ovate-oblong, nearly entire, on short petioles: flowers few or solitary, drooping in the bud: petals purple: pods glabrous. — Throughout the northern part of the continent; in the Rocky Mountains as far south as Colorado.

5. *E. affine*, Bong. Stem erect, 6 inches to a foot high, simple, glabrous: leaves sessile, partly clasping, irregularly denticulate: flowers sessile: petals 2-cleft. — Torr. & Gray, Fl. i. 489. W. Montana and northward.

6. *E. palustre*, L., var. *lineare*, Gray. Erect, 1 to 2 feet high, branched above, minutely hoary pubescent: leaves narrowly lanceolate or linear, nearly entire: flower-buds somewhat nodding: petals purplish or white: pods hoary. — *E. palustre*, var. *albiflorum*, Lehm. Colorado and northward, thence across the continent to New England.

7. *E. coloratum*, Muhl. Stem erect, 1 to 3 feet high, glabrous or nearly so: leaves lanceolate to ovate-oblong, denticulate; the middle ones sometimes decurrent; the lower slightly petioled: flower-buds erect: petals purplish, emarginate or 2-cleft: pods minutely pubescent. — Includes *E. tetragonum* of the Western reports. From Colorado northward, and eastward throughout the N. United States.

8. *E. oranifolium*, Lam. Stem generally simple, terete, 6 to 12 inches high, with two pubescent lines: leaves more or less petioled; the lower rounded, the middle ones oval and equally pointed at each end, the upper acuminate: flowers large, varying from dark purple to pure white: capsules sometimes nodding. — In the Sierras from California northward, and extending into the Bitter Root Mountains.

+ + *Annuals.*

9. *E. paniculatum*, Nutt. Glabrous or pubescent above: stem erect, 10 inches to 10 feet high, dichotomous above: leaves narrowly linear, obscurely serrulate, mostly alternate and fascicled; the uppermost subulate: flowers few, terminating the spreading filiform and almost leafless branches: petals obcordate. — Torr. & Gray, Fl. i. 490. From Colorado through Montana and Washington.

3. GAYOPHYTUM, A. Juss.

Calyx-lobes reflexed. Petals white or rose-colored. — Very slender branching annuals, with linear entire leaves, and very small axillary flowers.

1. *G. ramosissimum*, Torr. & Gray. Glabrous, or the inflorescence puberulent, *diffusely much branched*: flowers $\frac{1}{2}$ line long, *mostly near the ends of the branches*: capsule oblong, 2 or 3 lines long, on pedicels of about the same length or shorter, often deflexed, 3 to 5-seeded. — Fl. i. 513. Colorado and northward, and westward to Oregon and California.

2. *G. racemosum*, Torr. & Gray. Glabrous, or more or less canescent with short appressed pubescence, *the elongated branches mostly simple*: flowers $\frac{1}{2}$ line long, *axillary the whole length of the branches*: capsules linear, *sessile or very shortly pedicelled*, 8 to 10 lines long, *usually many-seeded*. — Fl. i. 514. Colorado and northward, thence westward to Washington and California.

4. CENOTHERA, L. EVENING PRIMROSE.

Calyx-lobes reflexed. Petals obcordate or obovate. Stamens 8. Capsule coriaceous or somewhat woody to membranaceous. — Herbs, or sometimes woody at base: flowers axillary, spicate, or racemose. — Watson, Proc. Am. Acad. viii. 573.

§ 1. *Stigma lobes linear, elongated: calyx-tube linear, slightly dilated at the throat: anthers linear.*

* *Caulescent: flowers in a leafy spike, erect in the bud, yellow: capsules sessile, coriaceous: seeds in two rows.*

+ *Capsules oblong, slightly attenuate above: seeds with more or less margined angles, nearly smooth.*

1. *C. biennis*, L. Erect, rather stout, 1 to 5 feet high, usually simple: calyx-tube 1 to $2\frac{1}{2}$ inches long: capsule $\frac{3}{4}$ to 1 inch long. — Common everywhere and very variable.

Var. *grandiflora*, Lindl. Petals equalling the calyx-tube. — Same range, but less common eastward.

+ + *Capsules linear: seeds not margined, minutely tuberculate.*

2. *C. rhombipetala*, Nutt. Spike elongated, dense: calyx silky-canescens: petals rhombic-ovate. — Torr. & Gray, Fl. i. 493. Probably within the eastern limits of our range, and thence to the Indian Territory and northward to Minnesota.

* * *Caulescent: flowers nodding in the bud, white turning to rose-color: capsules sessile, mostly linear: seeds in a single row.*

3. *C. pinnatifida*, Nutt. Annual or biennial: *calyx-tips not free, throat naked: seeds oval, not angled, finely pitted*. — Along the eastern slope of the Rocky Mountains from the Dakotas to the Indian Territory and New Mexico.

4. *C. trichocalyx*, Nutt. Annual: *calyx very villous; the tips not free, throat naked: seeds lance-linear, smooth*. — Torr. & Gray, Fl. i. 494. *C. deltoidea*, Torr. From W. Wyoming to California, and thence to Arizona and New Mexico.

5. *Œ. albicaulis*, Nutt. Perennial: *stems white and shreddy: calyx-tips free, throat naked: seeds smooth, lance-linear.* — A very variable species. From New Mexico and Colorado to Washington and British America.

6. *Œ. coronopifolia*, Torr. & Gray. Perennial: *calyx-tips short, free, throat very villous: capsule oblong: seeds ovate, angled, tuberculate.* — Fl. i. 495. From Nebraska to the Uintas, and southward to New Mexico.

* * * *Acaulescent, or nearly so: flowers erect in the bud, white or rose-color: capsules mostly sessile, ovate or ovate-oblong, obtusely or sharply angled, large and rigid.*

7. *Œ. cæspitosa*, Nutt. *Capsule oblong, ribbed, often doubly crested on the angles: calyx-tube 2 to 7 inches long: petals $\frac{3}{4}$ to $1\frac{1}{4}$ inches long.* — *Œ. marginata*, Nutt. From the Upper Missouri to Nebraska and southward to Nevada, New Mexico, etc.

8. *Œ. triloba*, Nutt. *Capsule ovate, persistent, strongly winged, net-reined: calyx-tips free, the tube 2 to 4 inches long: petals $\frac{1}{2}$ to 1 inch long.* — From British Columbia to Mexico, and westward to California.

Var. (?) *parviflora*, Watson. Flowers very small, about an inch or two long, fertilized in the bud and rarely fully opening: fruit abundant, forming at length a densely crowded hemispherical or cylindrical mass, nearly 2 inches in diameter and often 2 or 3 inches high. — Proc. Am. Acad. xii. 251. Plains of Kansas and Nebraska.

9. *Œ. brachycarpa*, Gray. *Capsule ovate, winged, more or less corky, smooth: calyx-tube 2 to 4 inches long: petals $1\frac{1}{2}$ inch long, purplish: seed-testa thickened.* — Pl. Wright. i. 70. ? *Œ. marginata*, var. *purpurea*, of the various reports. From Montana to Nevada, New Mexico, and W. Texas.

* * * * *Caulescent: flowers axillary: capsule ovate to orbicular, strongly angled and broadly winged.*

10. *Œ. canescens*, Torr. Low: capsule ovate, 3 to 4 lines long: petals white and rose-color, 6 lines long: calyx-tube 6 to 8 lines long. — From the headwaters of the Platte to New Mexico.

11. *Œ. Missouriensis*, Sims. Capsule 1 to 3 inches long, with wings nearly as broad: calyx-tube 2 to 5 inches long: petals 1 to $2\frac{1}{2}$ inches long, yellow: seeds strongly crested. — From Missouri to Colorado and Texas.

§ 2. *Stigma capitate: calyx-tube linear, persistent: flowers erect in the bud, yellow: anthers oblong: capsules sessile, linear to ovate: seeds in two rows: mostly aculescent.*

12. *Œ. breviflora*, Torr. & Gray. Subpubescent: leaves deeply pinnatifid: calyx-tube 3 to 6 lines long: petals 3 lines long. — Wyoming, Colorado, Utah, and westward.

§ 3. *Stigma discoid: calyx-tube more broadly dilated above: flowers erect in the bud, yellow, axillary: anthers oblong-linear: capsule mostly sessile, linear-cylindric.*

13. *Œ. Hartwegi*, Benth. Low, 3 to 15 inches high: leaves numerous, linear to lanceolate, mostly entire: calyx-tube 1 to 2 inches long, the tips free and linear: petals 4 to 12 lines long: capsule 8 to 10 lines long.

Var. *lavandulæfolia*, Watson. Taller, pubescent throughout: leaves mostly linear and shorter: calyx-segments less attenuated above. — *Æ. lavandulæfolia*, Torr. & Gray. From Kansas and Colorado to Mexico.

14. *Æ. serrulata*, Nutt. *Leaves* linear to lanceolate, *denticulate*: the *free calyx-tips short*: capsules 9 to 15 lines long. — From New Mexico and Texas northward to British America.

§ 4. *Stigma capitate*: *calyx-tube obconic or short funnel-form*: *flowers in crowded bracteate or leafy spikes*: *anthers oblong*: *capsule linear, sessile, attenuated above, curved and contorted*.

15. *Æ. strigulosa*, Torr. & Gray, var. *pubens*, Watson. *Pubescence hirsute and spreading*, sometimes nearly smooth: *petals 1 to 2 lines long, yellow*, usually turning red: *capsule very narrowly linear, often short-pedicelled*. — Includes *Æ. dentata*, Torr. & Gray. From the Wasatch westward through the Pacific States.

16. *Æ. andina*, Nutt. Dwarf, 1 to 3 inches high, *canescently puberulent*: *flowers a line long, yellow*: *capsule fusiform, 3 to 6 lines long*. — From E. Oregon to Montana, Wyoming, Nevada, and Utah.

§ 5. *As in § 4, but capsules linear to clavate, pedicelled and obtuse*: *caulescent*: *flowers in loose, naked racemes*: *seeds oblong-lanceolate*.

17. *Æ. scapoidea*, Nutt. *Puberulent or nearly glabrous*: leaves low on the stem, usually lyrate-pinnatifid: *calyx-tips not free*: *capsule 4 to 12 lines long*. — From W. Wyoming and S. Idaho to S. Utah and Colorado.

18. *Æ. brevipes*, Gr. Like the last, but stouter: *villous*, not puberulent: *calyx-tips free, thick*: *capsule 1 to 3 inches long*.

Var. *parviflora*, Watson. *Of a much more branching habit*: the leaves more distinctly pinnate: inflorescence more slender: flowers pale yellow, the petals 2 to 3 lines long. — Am. Nat. ix. 271. S. W. Colorado and S. Utah.

5. CLARKIA, Pursh.

Petals purple or violet. Anthers oblong or linear. Stigma with 4 broad lobes. Capsule linear, attenuate above, somewhat 4-angled. Seeds angled or margined. — Annuals, with erect brittle stems: leaves on short slender petioles, the uppermost sessile: flowers showy, nodding in the bud, in terminal racemes.

1. *C. pulchella*, Pursh. *Leaves linear-lanceolate to linear*: *petals 3-lobed, attenuate to a long claw which has a spreading tooth on each side*: perfect stamens with a linear scale on each side at base; *alternate stamens rudimentary and filiform*: *capsule 8-angled*. — Bitter Root Valley, W. Montana, to Idaho, Oregon, and Washington.

2. *C. rhomboidea*, Dougl. *Leaves oblong-lanceolate to oblong-ovate*: *petals entire, rhomboidal, with a short broad claw which is often broadly toothed*: *anthers all perfect*: *filaments with hairy scales at the base*: *capsule 4-angled*. — From the Wasatch to California and Washington.

6. STENOSIPHON, Spach.

Tube of the calyx filiform or almost capillary, much prolonged beyond the ovary, recurved or declined after flowering. Petals unguiculate, unequal.

Fruit (very small) coriaceous, ovate, convex externally, flattish within, about 8-ribbed. — A tall perennial herb, with virgate branches: linear-lanceolate, sessile, entire leaves, gradually reduced to bracts: flowers white, sessile, crowded in long and strict virgate spikes.

1. **S. virgatus**, Spach. Spikes in fruit sometimes nearly one foot long: bracts subulate, longer than the ovary: calyx pubescent, 4 to 5 lines long: petals rather large in proportion: ovary tomentose-pubescent. — From Colorado to Arkansas and Texas.

7. GAURA, L.

Calyx-tube prolonged beyond the obconic or clavate ovary. Petals with claws. Style hairy below. Fruit obtusely 4-angled and ridged upon the sides. — Leaves sessile: flowers in spikes or racemes, white or rose-colored, turning to red.

1. **G. biennis**, L. *Soft-hairy or downy, 3 to 8 feet high: leaves oblong-lanceolate, denticulate: fruit oval or oblong, ribbed, downy.* — Idaho and eastward to the Atlantic.

2. **G. parviflora**, Dougl. *Clothed, besides the long soft-villous hairs, with a minute slightly glandular pubescence, 2 to 5 feet high: leaves ovate-lanceolate, repand-denticulate, clothed on both sides with a soft velvety pubescence: spikes virgate, dense: fruit oblong-clavate, 4-nerved, obtusely angled above.* — From Washington to Texas.

3. **G. coccinea**, Nutt. *Canescent, puberulent or glabrate, 6 to 12 inches high, very leafy: leaves lanceolate, linear-oblong or linear, repand-denticulate or entire: flowers in simple spikes, rose-color turning to scarlet: fruit elliptical, terete, 4-sided above.* — Colorado to Montana and eastward to Arkansas and the Saskatchewan.

8. CIRCÆA, L. ENCHANTER'S NIGHTSHADE.

Calyx-tube slightly prolonged above the ovoid ovary, the base nearly filled by a cup-shaped disk. Petals obcordate. Fruit pear-shaped, covered with hooked bristles. — Low slender erect herbs: leaves thin, petiolate: flowers small, white, in terminal and lateral racemes: fruit on slender spreading or deflexed pedicels.

1. **C. Pacifica**, Ascherson & Magnus. *Mostly glabrous: leaves ovate, rounded or cordate at base, repandly denticulate: calyx white, with a very small tube: fruit a line long.* — The *C. alpina* of Fl. Colorado. From Colorado to the Saskatchewan and westward to California and Washington.

ORDER 32. LOASACEÆ.

Herbaceous plants with either stinging or jointed and rough-barbed hairs, no stipules, calyx-tube adnate to a one-celled ovary, parietal placenta, and a single style. Stamens usually very numerous, some of the outer occasionally petaloid. Flowers perfect, often showy.

1. MENTZELIA, L.

Calyx-tube cylindrical or turbinate: the limb 5-lobed. Petals 5 or 10. Stamens inserted below the petals on the throat of the calyx. Ovary truncate at the summit: style 3-cleft, the lobes often twisted. Capsule opening usually irregularly at the apex. — Erect, the stems becoming white and shining: leaves alternate, mostly coarsely toothed or pinnatifid: flowers cymose or solitary, orange or golden yellow to white.

* *Seeds few, oblong, not winged: petals 5, not large: filaments all filiform: leaves petioled, cut-toothed or angled.*

1. *M. oligosperma*, Nutt. Rough and adhesive, 1 to 3 feet high, much branched, branches brittle: leaves ovate and oblong: petals yellow, wedge-oblong, pointed: capsule about 9-seeded. — From the mountains eastward across the plains to Illinois and Texas.

* * *Seeds few to many, irregularly angled or somewhat cubical, not winged: petals 5, not large: filaments all filiform: capsule linear: leaves sessile, sinuately toothed or pinnatifid.*

2. *M. albicaulis*, Dougl. Slender, 3 inches to a foot high or more: leaves linear-lanceolate, pinnatifid with numerous narrow lobes, upper leaves broader: flowers mostly approximate near the ends of the branches: petals spatulate or obovate: capsule linear-clavate: seeds numerous, rather strongly tuberculate, irregularly angled with obtuse margins. — Torr. & Gray, Fl. i. 534. From New Mexico and Colorado to Oregon and California.

3. *M. dispersa*, Watson. Very similar, but the leaves sinuate-toothed, sometimes entire, rarely pinnatifid, the uppermost often ovate: seeds somewhat cubical and very nearly smooth. — Proc. Am. Acad. xi. 115. *M. albicaulis*, var. *integrifolia*, Watson. From Colorado through Idaho to Washington and California.

* * * *Seeds numerous, suborbicular-winged or narrowly-margined: petals 5 or 10, often large and showy: outer filaments often petaloid: capsule broad, oblong: leaves as in the last.*

+ *Flowers vespertine, yellowish white.*

4. *M. ornata*, Torr. & Gray. Rough with short-barbed hairs: leaves oblong-lanceolate, the segments rather acute: flowers very large, terminating the branches, bracteolate: petals 10, about 2 inches long: filaments all filiform: capsule 5 to 7-valved at the summit: seeds scarcely margined. — Fl. i. 534. Along the Missouri and its tributaries: also in S. W. Colorado.

5. *M. nuda*, Torr. & Gray. Rough with minute barbed pubescence: leaves somewhat lanceolate, the segments obtuse: flowers about half the size of the last, not bracteolate: petals 10: exterior filaments petaloid and often sterile: capsule 3-valved at the summit: seeds plainly winged. — Loc. cit. 535.

+ + *Flowers expanding only in bright sunshine, bright yellow: leaves lanceolate.*

6. *M. lævicaulis*, Torr. & Gray. Stout, 2 or 3 feet high: flowers sessile on short branches, very large: calyx-tube naked: petals acute at each end, 2 to 2½ inches long: seeds very minutely tuberculate. — Loc. cit. W. Wyoming and Montana to the Columbia River and S. California.

7. *M. pumila*, Torr. & Gray. Rather stout, 8 to 10 inches high: lower leaves somewhat petioled: flowers small, solitary or three together, terminating

the loose flowering branches, *slightly pedicellate, with 1 or 2 bracts at base*: outer filaments flat. — Loc. cit. *M. Wrightii* of Fl. Colorado. S. Colorado, southward and westward.

8. *M. chrysantha*, Engelm. Stems 1 to 2 feet high, branching: leaves ovate-lanceolate, the lower narrowed towards the base: flowers subsessile: *petals 6 to 9 lines long, acute, often less than 10, the innermost smaller and antheriferous: seeds narrowly margined but not winged.* — Brandegee's Fl. S. W. Col. 237. Differs from *M. pumila* in its larger flowers and seeds not winged. Near Cañon City, Colorado, and S. Utah.

9. *M. multiflora*, Gray. Stems scabrous, pubescent, a span to a foot high: leaves attenuate below: *flowers more numerous, subtended by 1 or 2 bracts: petals deep yellow, abruptly pointed, 6 to 9 lines long.* — Pl. Fendl. 48. Colorado and southward.

ORDER 33. CUCURBITACEÆ. (GOURD FAMILY.)

Herbs, mostly tendril-bearing and climbing, rather succulent, with alternate and palmately veined or lobed leaves and no proper stipules, flowers monœcious or diœcious, with petals more commonly united into a cup or tube and also blended with the calyx. Sterile flowers with two 2-celled anthers and one 1-celled; the cells usually long and contorted. Fertile flowers with the calyx-tube adnate to a 1 to 3-celled ovary.

1. *Cucurbita*. Flowers all solitary, large, yellow. Corolla 5-cleft. Fruit smooth, indehiscent, 1-celled, many-seeded.
2. *Echinocystis*. Sterile flowers in compound racemes, small, greenish white. Corolla 6-parted. Fruit prickly, bursting at the top, 2-celled, 4-seeded.

1. CUCURBITA, L. PUMPKIN, SQUASH, ETC.

Flowers monœcious. Calyx-tube and corolla campanulate. Sterile flowers with the stamens at the base. Fertile flowers with 3 rudimentary stamens: ovary oblong, with 3 placentæ. Fruit fleshy, often with a hard rind. Seed ovate or oblong, flattened. — Mostly prostrate and rooting at the joints: leaves cordate: tendrils compound.

1. *C. perennis*, Gray. Root fleshy, very large, 6 inches to 3 feet thick, yellow inside: leaves cordate-ovate or triangular, undivided or subsinuate-repand, margin denticulate: fruit globose, yellow, 2 or 3 inches in diameter. — Pl. Lindh. 193. From Colorado to Texas and Mexico, and westward to California.

2. ECHINOCYSTIS, Torr. & Gray. WILD BALSAM-APPLE.

Flowers monœcious. Petals united at the base into an open spreading corolla. Fruit fleshy, at length dry. — Tall climbing plants, nearly smooth, with 3-forked tendrils, thin leaves, fertile flowers in small clusters or solitary, from the same axils as the sterile.

1. **E. lobata**, Torr. & Gray. Root annual: leaves deeply and sharply 5-lobed: fruit oval, 2 inches long: seeds flat, dark-colored. — Colorado and eastward, in rich soil, to New York and Canada.

ORDER 34. **CACTACEÆ.** (CACTUS FAMILY.)

Green fleshy and thickened persistent mostly leafless plants, of peculiar aspect: globular or columnar, tuberculated or ribbed, or jointed and often flattened, usually armed with bundles of spines from the *areolæ*. Flowers with numerous sepals, petals, and stamens, usually in many rows, the cohering bases of all of which coat the inferior one-celled many-ovuled ovary, and above it form a tube or cup, nectariferous at base. Style one, with several or numerous stigmas. Fruit a pulpy or rarely dry one-celled berry.

§ 1. No leaves proper: spines never barbed. Flower-bearing and spine-bearing areolæ distinct. Tube of the sessile solitary flowers well developed, often long. Seeds brown or black, mostly small. — **CACTEÆ.**

1. **Mamillaria.** Globose or oval plants, covered with spine-bearing tubercles. Flowers from between the tubercles. Ovary naked.
2. **Echinocactus.** Globose or oval plants, stouter than the last, usually ribbed: bundles of spines on the ribs. Flowers from the youngest part of the ribs close above the nascent bunches of spines. Ovary covered with sepals.
3. **Cereus.** Oval or columnar plants, sometimes tall, ribbed or angled: bundles of spines on the ribs. Flowers close above the bundles of full grown (older) spines. Ovary covered with sepals.

§ 2. Leaves small, subulate, early deciduous. Sessile and solitary flowers from the same areolæ as the always barbed spines. Tube of the flowers short, cup-shaped. Seeds larger, whitish, covered with a bony arillus. — **OPUNTIEÆ.**

4. **Opuntia.** Branching or jointed plants: joints flattened or cylindrical.

1. **MAMILLARIA**, Haw.

Flowers about as long as wide: the tube campanulate or funnel-shaped. Ovary often hidden between the bases of the tubercles, the succulent berry exsert. Seeds yellowish-brown to black.

1. **M. vivipara**, Haw. Simple or cespitose: the almost terete tubercles bearing *bundles of 5 to 8 reddish brown spines, surrounded by 15 to 20 grayish ones* in a single series, all straight and very rigid: *flowers purple*, with lance-subulate petals and fringed sepals: *berry oval, green*: seed pitted, light brown. — A variable species, ranging across the plains and along the eastern slopes of the mountains.

2. **M. Missouriensis**, Sweet. *Smaller, globose, simple, with fewer (10 to 20) weaker ash-colored spines: flowers yellow: berries scarlet, subglobose: seeds globose, pitted.* — **M. Nuttallii**, Eng. Common along the eastern slopes of the mountains and upon the plains.

Var. **cæspitosa**, Watson. Cespitose, with 12 to 15 straight white spines: berry shorter than the tubercles, red. — Bibliog. Index, i. 403. **M. Nuttallii**, var. *cæspitosa*, Eng. Eastern slopes of the mountains of Colorado and southward.

2. ECHINOCACTUS, Link & Otto.

Flowers about as long as wide. Ovary covered with few (in ours) sepalioid scales, which are naked or woolly in their axils. Fruit succulent or dry, covered with the persistent scales, sometimes enveloped in copious wool, and usually crowned with the remnants of the flower. Seed obliquely obovate, black.

1. **E. Simpsoni**, Eng. Simple, globose or depressed, *with orate tubercles bearing about 20 outer ash-colored spines and 5 to 10 stouter darker inner ones*, all straight and rigid: flowers yellowish green to purplish: berry dry, with few black tuberculated seeds. — From the eastern slopes of the Colorado mountains westward to Utah and Nevada.

2. **E. Whipplei**, Eng. & Big. Simple, globose or ovate, *with 13 to 15 compressed and interrupted ribs: 7 to 11 outer spines and 4 inner ones; the ivory-white upper ones longest, broadest, recurved or twisted; the lower shorter, darker and terete; the lowest middle one hooked*: flowers yellow: seeds large, minutely tuberculated. — From S. Colorado westward to S. California.

3. CEREUS, Haw.

Flowers about as long as wide or elongated. Scales of the ovary distinct, with naked or woolly axils, or almost obsolete and the axils spiny. Berry succulent, covered with spines or scales or almost naked. Seeds black. — Fruit often edible. Our species all belong to § ECHINOCEREUS, which includes low and usually cespitose plants, with numerous oval or cylindric heads, short flowers, green stigmas and spiny fruit, the seeds covered with confluent tubercles.

1. **C. viridiflorus**, Eng. Ovate or at length cylindrical, simple or sparingly branched, 1 to 2 inches high: *ribs about 13: areolæ ovate-lanceolate: spines strictly radiating, 12 to 18, with 2 to 6 superior setaceous ones, the rest lateral and longer, the lower frequently purplish brown, the others white, central one often wanting, when present stouter, solitary, and variegated: flowers lateral towards the apex, yellow, becoming green: berries elliptical, small*. — Pl. Fendl. 50. Common in Colorado and southward.

2. **C. Fendleri**, Eng. Ovate-cylindrical, 3 to 8 inches high: *ribs 9 to 12: areolæ rather crowded: spines very variable, always bulbous at base, radial ones 7 to 10, straight or curved, white and brown, lower ones stronger, central one stout, curved above, dark brown, often elongated: flowers lateral below the top, large, 2 to 3 inches in diameter, of a deep purple color: berry 1 to 1½ inches long, edible*. — Pl. Fendl. 50. S. Colorado and southward.

3. **C. gonacanthus**, Eng. & Big. Ovate, simple or sparingly branched from the base, 7-ribbed: *areolæ large, orbicular, distant: spines robust, angled, straight or variously curved; radial ones 8, yellowish, often blackish at base and apex, the upper one much larger than the others, nearly equalling the central one, which is remarkably stout, angular, and channelled: flowers scarlet, open day and night*. — Pac. R. Rep. iv. 33, t. 5. S. Colorado and southward.

4. **C. phœniceus**, Eng. Heads 2 to 3 inches high, *generally forming dense hemispherical masses a foot or more in diameter: ribs 9 to 11: areolæ ovate-orbiculate, somewhat crowded: spines setaceous, straight, radial ones 3 to 12,*

upper ones a little shorter, *central ones 1 to 3, bulbous at base, terete, a little stronger, lowest one longest.* — Pac. R. Rep. iv. 34, t. 4. S. Colorado and southward.

5. **C. conoideus**, Big. Heads 3 to 4 inches high, few from one base, of unequal height, ovate, *acutish towards the apex, conoid: ribs 9 to 11: radial spines 10 to 12, slender, rigid, upper ones 2 to 5 lines long, lateral ones 6 to 15 lines, upper central spines hardly longer than the lateral ones, lower one 1 to 3 inches long, angular and often compressed.* — Pac. R. Rep. iv. 36. S. Colorado and southward.

6. **C. paucispinus**, Eng. Stem 5 to 9 inches high, 2 to 3 inches in diameter, ovate-cylindrical, sparingly branching or simple: *ribs 5 to 7: areolæ remote: spines strong, 9 to 16 lines long, dark-colored, radial ones 3 to 6, central wanting or rare, stout, subangled.* — Pac. R. Rep. iv. 34. S. Colorado and southward.

4. OPUNTIA, Tourn.

Petals spreading or rarely erect. Berry succulent or sometimes dry, marked with bristly or spiny areolæ, truncate. — Articulated much-branched plants, of various shapes, low and prostrate, or erect and shrub-like.

§ 1. *Joints compressed: rhaps forming a prominent bony margin around the seed.*

* *Fruit pulpy.*

1. **O. Camanchica**, Eng. & Big. Large, prostrate, extensively spreading: *joints ascending, 6 to 7 inches long, suborbiculate: areolæ remote, numerous, armed: bristles straw-colored or brownish, few: spines 1 to 3, compressed, brownish, paler at the apex, 1 to 3 inches long, upper ones elongated, suberect, the others deflexed: berry large, ovate, widely umbilicate: seeds angled, deeply notched at the hilum.* — Pac. R. Rep. iv. 40. S. Colorado and southward.

2. **O. Rafinesquii**, Eng. *Joints deep green, prostrate, broadly obovate or orbicular: leaves spreading: bristles bright red-brown: spines few and small with a single strong one: flowers sulphur-yellow, mostly with a red centre: berry narrowed at the base, with a funnel-shaped umbilicus* — Pac. R. Rep. iv. 43. From Colorado eastward across the plains to Wisconsin and Kentucky.

Var. (!) **fusiformis**, Eng. & Big. *Roots forming fusiform tubers: bristles stout and yellowish brown: flowers smaller and with fewer sepals: seed larger and thicker.* — Pac. R. Rep. iv. 43. From the Missouri southward across the plains.

* * *Fruit dry and prickly.*

3. **O. Missouriensis**, DC. Prostrate: *joints broadly obovate and tuberculate, 2 to 4 inches long: leaves minute; their axils armed with a tuft of straw-colored bristles and 5 to 10 slender radiating spines 1 to 2 inches long: flowers light yellow.* — Frequent on the plains and in the mountains, and extending eastward to Wisconsin.

4. **O. rutila**, Nutt. Prostrate, *with thick obovate or elongated joints, 2 to 4 inches long, sometimes thick and almost terete: areolæ close, armed with numerous slender reddish or gray flexible spines: flowers purple: berry deeply umbilicate: seeds large, flat, broadly margined, ivory-white.* — Torr. & Gray, Fl. i. 155. S. Wyoming to Utah and westward.

5. *O. fragilis*, Haw. Joints small, ovate, compressed or tumid or even terete, 1 to $1\frac{1}{2}$ inches long, fragile: larger spines 4, cruciate, mostly yellowish brown, with 4 to 6 smaller white radiating ones below; bristles few: flowers yellow: fruit with 20 to 28 clusters of bristles, only the upper ones with a few short spines. — From the Upper Missouri and Yellowstone to New Mexico.

§ 2. Joints cylindrical, more or less tuberculated: seed not margined.

6. *O. arborescens*, Eng. Arborescent, 5 to 6 feet high (much higher farther south): branches numerous, verticillate, horizontal or pendulous: joints verticillate: tubercles cristate, prominent: spines 8 to 30, divaricately stellate: berry sub-hemispherical, tuberculate-cristate, yellow, unarmed. — Wisliz. Rep. 6. Abundant from Central Colorado southward.

ORDER 35. FICOIDEÆ.

A miscellaneous group, chiefly of fleshy or succulent plants, with mostly opposite leaves and no stipules; differing from *Caryophyllaceæ* and *Portulacaceæ* by having distinct partitions to the ovary and capsule; the stamens sometimes numerous, as in *Cactaceæ*; petals wanting in ours.

1. *Sesuvium*. Calyx-lobes 5, petaloid. Stamens 5 to 60. Capsule circumscissile. Succulent.

2. *Mollugo*. Sepals 5. Stamens 3 or 5. Capsule 3-valved. Not succulent.

1. SESUVIUM, L. SEA PURSLANE.

Calyx-tube turbinate; the lobes apiculate on the back near the top, membranously margined. Styles 3 to 5. Capsule ovate-oblong. — Smooth branching mostly prostrate herbs: leaves opposite, linear to spatulate, entire: flowers axillary and terminal, solitary or clustered.

1. *S. Portulacastrum*, L. Leaves linear-lanceolate to oblong-lanceolate: flowers sessile or pedicellate: calyx-lobes more or less purple: stamens many. — From California through Nevada and Colorado to New Mexico.

2. MOLLUGO, L. CARPET-WEED.

Stamens hypogynous. Styles 3. Seeds longitudinally sulcate on the back. — Low and much branched, glabrous: leaves spatulate to linear-oblancoolate, entire, opposite and apparently verticillate: flowers mostly on long pedicels and axillary.

1. *M. verticillata*, L. Prostrate: pedicels umbellately fascicled at the nodes: capsule oblong-ovoid: seeds reniform, shining. — From Colorado to Arizona and New Mexico; also in California and the Atlantic States.

ORDER 36. UMBELLIFERÆ. (PARSLEY FAMILY.)

Herbs, with small flowers in umbels, five epigynous stamens and petals, and two styles; the calyx adnate to the 2-celled ovary, which

contains one ovule in each cell; and the fruit splitting into a pair of dry seed-like indehiscent carpels. Stem commonly hollow. Leaves mainly alternate, mostly compound, often decomposed, the petiole expanded or sheathing at base. Umbels usually compound, forming *umbellets*. The bracts under the general umbel form an *involucre*, under an umbellet an *involucel*. The enlarged base of the styles is the *stylopodium*, which is often surrounded by an epigynous disk. Each carpel has usually 5 longitudinal ribs: in the intervals are usually one or more longitudinal oil-tubes, or *vittæ*. The face by which the two carpels cohere is the *commissure*: a slender prolongation of the axis between them is the *carpophore*; this is apt to split into two branches, a carpel suspended from the tip of each.

I. Umbels irregularly compound, the flowers capitate in the umbellets. Oil-tubes obscure.

1. **Sanicula.** Leaves lobed and incised. Flowers polygamous, mostly yellow. Fruit covered with hooked prickles or tubercles.

II. Umbels regularly compound. Fruit without prominent secondary ribs and not furnished with hooked or barbed prickles.¹ Oil-tubes rarely wanting.

* Fruit more or less compressed laterally, broadly ovate or subglobose to elliptic-oblong, not broadly winged.

+ Seed with sides moderately incurved: carpophore 2-cleft: flowers yellow or white.

2. **Musenium.** Fruit ovate or ovate-oblong: ribs 5, filiform, slightly prominent: oil-tubes 2 or 3 in the intervals.

3. **Orogenia.** Fruit ovoid: ribs 5, the 3 dorsal ones filiform, the lateral thickened, corky and involute: oil-tubes obscure, 3 in each interval.

+ + Seed nearly terete or but slightly concave on the face.

+ + Fruit not prominently ribbed: carpophore bifid or 2-parted. Involucre and involucels usually present. Flowers white.

4. **Carum.** Fruit ovate or oblong: ribs filiform: oil-tubes solitary.

5. **Berula.** Fruit nearly globose, emarginate at base, with thickened epicarp: oil-tubes numerous and contiguous: leaflets ovate-oblong to linear, laciniately toothed.

+ + Fruit with 5 strong ribs: carpophore 2-parted.

= Involucre none: flowers yellow: leaves all simple.

6. **Bupleurum.** Fruit ovoid-oblong, with or without oil-tubes: leaves entire.

= = Involucres and involucels usually present: flowers white: leaves pinnate to pinnately decomposed.

7. **Cicuta.** Fruit broadly ovate, with thick obtuse wings: oil-tubes solitary.

8. **Sium.** Fruit globular: ribs wing-like: oil-tubes 1 to 3 in the intervals.

* * Fruit somewhat compressed laterally, linear-oblong, with broad commissure, not winged: seed sulcate or reniform in section: carpophore 2-parted, persistent: flowers white.

9. **Osmorrhiza.** Fruit narrowly attenuate at base, hispid on the acutish angles: oil-tubes very obscure: seed sulcate on the face or somewhat involute: umbels nearly naked: leaflets ovate, cleft and toothed.

10. **Glycosma.** Similar, but fruit not attenuate at base, very rarely hispid: seed broadly sulcate.

¹ The introduced genus *Daucus* has the secondary ribs most prominent and armed with barbed or hooked prickles, and solitary oil-tubes under the wings or ribs. See foot-note, p. 121.

* * * Fruit more or less compressed dorsally, oblong to orbicular.

← Fruit somewhat compressed dorsally: the dorsal ribs rather narrowly winged; the lateral wings broader, distinct: seed sulcate and concave.

11. **Ligusticum.** Dorsal ribs narrowly winged: oil-tubes several in the intervals, obscure: seed uniform in section: flowers white or yellow.

12. **Thaspium.** Dorsal ribs strong and winged: oil-tubes solitary in the intervals: seed orbicular and somewhat angled in section: flowers yellow.

+ + Fruit much flattened dorsally.

+ + Lateral wings broad, distinct; the dorsal more or less prominent: seed concave on the face or nearly flat.

13. **Angelica.** Dorsal wings narrower than the lateral: oil-tubes solitary: stout herbs, with white flowers and naked or nearly naked umbels.

14. **Archangelica.** Similar, but with stouter ribs, and 2 to 3 or more oil-tubes in each interval adhering to the loose seed.

15. **Cymopterus.** Dorsal wings as broad as the lateral ones: oil-tubes one to several in the intervals: low perennial herbs: flowers yellow or white: involucre present.

+ + Lateral wings coherent till maturity: dorsal ribs filiform: seed nearly flat on the face.

16. **Peucedanum.** Lateral wings thin: oil-tubes as long as the fruit: involucre none: low perennials: flowers yellow or white, not radiate.

17. **Heracleum.** Lateral wings thin: oil-tubes solitary, clavate, not reaching the base of the fruit: involucre deciduous: stout pubescent perennials, with white, often radiate flowers.

18. **Archemora.** Lateral wings thin, broad: oil-tubes solitary: involucre nearly none: smooth perennials, with white flowers and rather rigid leaves.

19. **Ferula.** Lateral wings corky, as thick as the fruit: dorsal ribs filiform: oil-tubes very numerous, mostly obscure.

20. **Polytænia.** Lateral wings corky, tumid, thicker than the fruit: back nearly ribless: oil-tubes two in the intervals.

1. SANICULA, Tourn. SANICLE. BLACK SNAKEROOT.

Calyx-teeth foliaceous, persistent. Fruit subglobose or obovoid: ribs obsolete: oil-tubes numerous. Seed hemispherical. — Smooth perennials, with nearly naked stems: leaves palmately divided; the lobes more or less pinnatifid or incised: umbels involucrate with sessile leafy usually toothed bracts; the bracts of the involucre small and entire.

1. **S. Marylandica**, L. Stem 2 to 3 feet high: leaves all 5 to 7-parted: sterile flowers numerous, on slender pedicels: styles elongated and conspicuous, recurved. — Colorado and W. Montana; common throughout the Atlantic States.

2. MUSENIUM, Nutt.

Calyx-teeth persistent. Petals obovate, with inflexed point. — Perennial, dwarf, rather fetid, resiniferous herbs, with fusiform roots and a short caudex, or branching dichotomously from the base: leaves 2 to 3-pinnatifid: involucre none; involucre unilateral, of a few rather rigid narrow leaflets.

1. **M. divaricatum**, Nutt. Decumbent: stem short, dichotomously branching from the base: leaves, except the radical, opposite, glabrous, shining, bipinnatifid; divisions confluent with the winged rhachis: flowers yellow: fruit somewhat glabrous: oil-tubes filled with a strong terebinthine oil. — Torr. & Gray, Fl. i. 642. "Naked and arid hills of the Upper Missouri," Nuttall.

Var. **Hookeri**, Torr. & Gray. *Rhachis* narrow: fruit scabrous. — Loc. cit. *M. trachyspermum*, Nutt. From the Saskatchewan to the Upper Missouri, the Platte, and S. W. Montana.

2. **M. tenuifolium**, Nutt. *Acaulescent, erect and somewhat cespitose, of glaucous hue: leaves tripinnately divided; segments linear: flowers white: fruit nearly glabrous; oil-tubes with a more aromatic oil than in the former species.* — Loc. cit. "Rocky Mountains," Nuttall.

3. OROGENIA, Watson.

Calyx-teeth minute. Commissure with 2 to 4 oil-tubes: carpophore adnate to the carpels and forming a thick corky midrib dividing the hollowed face of the commissure longitudinally. — Dwarf, scarcely caulescent, glabrous: root tuberous: leaves radical, 1 to 2-ternate, with entire linear segments: umbel with few very short unequal rays.

1. **O. linearifolia**, Watson. Stem an inch or two above ground and very slender: leaves 2 or 3, upon filiform petioles, equalling the stem: umbels with 2 or 3 rays; umbellets 3 to 5-flowered: involucre none; involucels of 1 to 3 linear leaflets exceeding the rays. — Bot. King's Exp. 120, pl. 14. Wasatch Mountains, on damp shaded ridges.

4. CARUM, L.

Calyx-teeth small. Stylopodium conical. — Smooth, erect, slender biennial herbs or acaulescent, with tuberous or fusiform fascicled roots: leaves mostly simply pinnate with a few leaflets.

1. **C. Gairdneri**, Benth. & Hook. *Stem 1 to 4 feet high, from a tuberous root: leaves few, with 3 to 7 linear entire leaflets; the lower leaves rarely pinnate with entire or toothed divisions; upper leaves usually simple: involucre of a single linear leaflet, or often wanting; involucels of several linear bracts: flowers white.* — From Washington through Idaho to Wyoming, and thence to S. California. A common article of food among the Indians, who call it "yamp."

2. **C. (?) Hallii**, Watson. *Acaulescent* from a stout caudex branching at the summit: leaves pinnate or pinnatisect; leaflets or segments oblong or sub-ovate in outline, pinnately 3 to 7-lobed and few toothed: scape very simple, naked, surpassing the leaves, 10 inches high: involucel deeply parted: flowers yellow. — Bibl. Index, i. 416. *Seseli Hallii*, Gray. *Musenium Greenei*, Gray. Colorado.

5. BERULA, Koch.

Calyx-teeth minute. Stylopodium conical and styles short. Commissure broad. Seed terete. — A smooth perennial aquatic: leaves pinnate: involucre and involucels of several leaflets.

1. **B. angustifolia**, Koch. Erect, $\frac{1}{2}$ to 3 feet high, the stem stout and angled: leaflets about 6 pairs, ovate-oblong to linear, often laciniately lobed at base, and the upper ones especially more or less deeply cut-toothed: involucre and involucels of 6 to 8 entire linear-lanceolate leaflets. — *Sium angustifolium*, L. From Colorado northward, and eastward across the continent; also in California.

6. **BUPLÉURUM**, Tourn. THOROUGH-WAX.

Calyx-teeth obsolete. Fruit somewhat twin. — Herbs with simple entire leaves.

1. **B. ranunculoides**, L. Radical leaves linear-lanceolate; cauline ones clasping, cordate-oblong, striate: involucre about 3-leaved, unequal; leaflets of the involucre 5, ovate, mucronate. — Head-waters of Madison, Gallatin, and Snake Rivers.

7. **CICUTA**, L. WATER HEMLOCK.

Calyx-teeth small, acute. Stylopodium depressed. Commissure narrow. — Smooth, tall branching marsh perennials, with stout hollow stems: umbels many-rayed: roots thick and fascicled, very poisonous: flowering in summer.

1. **C. maculata**, L. Stout, 3 to 6 feet high: lower leaves on petioles 1 or 2 feet long, *bipinnate*; leaflets oblong-lanceolate, *coarsely serrate*: involucre usually wanting; involucre of 6 to 8 narrow lanceolate leaflets: flowers white: fruit broadly ovate. — Across the continent from the Atlantic to Washington and the Sierras.

2. **C. (?) trachypleura**, Watson. Stem a foot or more high, striate, 1 to 3-leaved, bearing 2 to 3 umbels on long peduncles: leaves *ternately decom-pound*, segments *filiform*: involucre and involucre of 1 to 3 small subulate leaflets: flowers yellow: fruit twin-ovate. — Bibl. Index, i. 417. *Thaspium trachypleu-rum*, Gray. Colorado.

8. **SIUM**, L. WATER PARSNIP.

Calyx-teeth obsolete (in ours). Stylopodium depressed and styles short. Commissure narrow. — Smooth perennial aquatics, with angled stems: leaves pinnate and leaflets serrate: involucre and involucre of several bracts: flowers white.

1. **S. cicutæfolium**, Gmelin. Tall: leaflets linear, lanceolate, or ob-long-lanceolate, tapering to a sharp point. — *S. lineare*, Michx. From Colorado to the Saskatchewan and the Atlantic; also along the Pacific slope.

9. **OSMORRHIZA**, Raf. SWEET CICELY.

Calyx-teeth obsolete. Carpels 5-angled. Seed terete, sulcate on the face or with margins contiguous and enclosing a central cavity. — Perennials, with thick aromatic roots, more or less hirsute: leaves large, 2 to 3-ternately com-pound: involucre small or none.

1. **O. nuda**, Torr. Rather slender, 2 or 3 feet high, *more or less pubes-cent with spreading hairs*: umbel long-peduncled, 3 to 5-rayed, usually naked: style and stylopodium very short. — Pacif. R. Rep. iv. 93. From Colorado westward and along the coast from California to Alaska. Closely allied to the Eastern *O. brevistylis*.

2. **O. longistylis**, DC. Branching, 2 or 3 feet high: leaflets sparingly pubescent or smooth with age, short-pointed: style slender, nearly as long as the ovary. — From the Dakotas eastward across the continent.

10. GLYCOSMA, Nutt.

Stylopodium depressed: seed semiterete or angled, with rather a broad sulcus. — Involucre and involucels wanting.

1. **G. occidentale**, Nutt. Rather stout, 2 feet high or more, finely puberulent throughout, excepting the inflorescence: leaves 2-ternate; leaflets oblong-lanceolate, serrate. — Torr. & Gray, Fl. i. 639. *Myrrhis occidentalis*, Benth. & Hook. Head-waters of Snake and Yellowstone Rivers to Oregon and California.

11. LIGUSTICUM, L. LOVAGE.

Calyx-teeth obsolete. Stylopodium usually conical; margin of the disk undulate. Fruit with a broad commissure. — Smooth perennials, usually tall: leaves pinnately or ternate and pinnately decomposed: umbels many-rayed, naked or involucre.

* *Flowers white.*

1. **L. apiifolium**, Benth. & Hook. Stems 2 to 4 feet high, leafy or naked, with 2 to 4 umbels on long peduncles: *leaves pinnately decomposed*, the segments incisely lobed; cauline leaves ternate, upon a short dilated sheath: *fruit $2\frac{1}{2}$ lines long*, with a *conical stylophore*: *seed with a central longitudinal ridge on the concave face*. — Probably the *Conioselinum Canadense* of Hayd. Rep 1872. Colorado and northward into Montana, but more abundant westward.

2. **L. scopulorum**, Gray. Very similar, but the fruit larger, 4 lines long, more broadly winged and ovate, and the *seed more depressed, almost reniform in section*. — Proc. Am. Acad. vii. 347. Colorado, alpine and subalpine.

3. **L. filicinum**, Watson. Rather slender, $1\frac{1}{2}$ feet high: *leaves broadly triangular in outline, ternate, the divisions bipinnate, and the segments deeply pinnatifid with linear acute lobes: stylophore obscure: seed obscurely ridged on the back*. — Loc. cit. xi. 140. *L. apiifolium*, of Bot. King's Exp. In the Wasatch and Uinta Mountains and Wyoming.

* * *Flowers yellow.*

4. **L. montanum**, Benth. & Hook. Very smooth: stem slender, 1 to 2 feet high: leaves 2-ternately divided; leaflets cuneiform, trifid; lobes oblong or lanceolate, sometimes linear, entire, or the larger ones incised. — Colorado and Arizona.

12. THASPIUM, Nutt. MEADOW-PARSNIP.

Calyx-teeth obsolete or short. — Perennial herbs, with 1 to 2-ternately divided leaves (or the root-leaves simple): umbels with no involucre and minute few-leaved involucels.

1. **T. trifoliatum**, Gray. Glabrous, stems somewhat branched: root-leaves or some of them round and heart-shaped; stem-leaves simply ternate or quinate, or 3-parted; the divisions or leaflets ovate-lanceolate or roundish, mostly abrupt or heart-shaped at the base, crenately toothed: flowers deep yellow. — Manual, 195. Colorado and northward into Montana, and eastward to the Atlantic States.

13. ANGELICA, L.

Calyx-teeth obsolete or minute. Stylopodium depressed. Fruit ovate, with a very broad commissure. — Usually tall and stout perennials (ours are glabrous or nearly so); leaves pinnate or compound, the toothed segments usually broad: umbels many-rayed.

* *Involucre and involuclcs none.*

1. **A. pinnata**, Watson. Stem rather slender, 2 to 3 feet high: leaves simply pinnate, with a tendency to be bipinnate in the lower pair of leaflets; leaflets 1 to 6 inches long, ovate to narrowly lanceolate, sharply and somewhat unequally serrate, occasionally entire. — Bot. King's Exp. 126. Wasatch and Uinta Mountains.

2. **A. Lyallii**, Watson. Stout, 4 or 5 feet high: leaves ternate-quinatc; the leaflets lanceolate, mostly cuneate at base, unequally dentate. — Proc. Am. Acad. xvii. 374. From Montana to Oregon and the British boundary.

* * *Involucre and involuclcs conspicuous.*

3. **A. Dawsoni**, Watson. Rather slender, 1 to 3 feet high: radical leaves biternate, the lanceolate leaflets 1 or 2 inches long, sharply and finely serrate, the terminal one sometimes deeply 3-cleft: cauline leaves (1 or 2 or none) similar: umbel solitary, the conspicuous involucre of numerous foliaceous lacerately toothed bracts nearly equalling the rays; involuclcs similar. — Proc. Am. Acad. xx. 369. Rocky Mountains near the British boundary, and probably in N. Montana.

14. ARCHANGELICA, Hoffm.

Calyx-teeth short. Seed becoming loose in the pericarp. — Much like *Angelica*.

1. **A. Gmelini**, DC. Stem a little downy at the summit, 1 to 3 feet high: leaves 2 to 3-ternately divided; leaflets ovate, acute, cut-serrate, glabrous: fruit oblong. — Colorado to Oregon and Bering Straits; also along the New England coast.

15. CYMPTERUS, Raf.

Calyx-teeth prominent or often small or obsolete. Stylopodium depressed. Fruit ovate or elliptical, obtuse or retuse. — Low and often cespitose, with a thickened root: leaves pinnately and finely decompound, with small narrow segments: umbels usually with both involucre and involuclcs.

* *Flowers yellow.*

1. **C. alpinus**, Gray. Caudex cespitose: leaves pinnatisect; pinnæ 3 to 5, approximate, 3 to 7-parted; segments linear-lanceolate, very entire, or the lower 2 to 3-cleft: scape 2 to 4 inches high, bearing a subcapitate umbel a little longer than the leaves: involuclcs 5 to 7-parted; segments equalling the golden flowers: wings of the fruit somewhat erose; oil-tubes 1 or 2 in the intervals, 4 on the commissure. — Am. Jour. Sci., 11. xxxiii. 408. High alpine, from Colorado to Montana.

2. **C. terebinthinus**, Torr. & Gray. Shortly caulescent, 6 to 18 inches high, leafy at base: leaves rather rigid, thrice pinnate: leaflets a line long or

less, linear-oblong, entire, or 1 to 2-toothed: involucre a single linear leaflet or wanting; involucels of several short bracts: oil-tubes 2 to 4 in the intervals, 4 to 10 on the commissure. — Fl. i. 624. *C. fœniculaceus*, Torr. & Gray. Colorado and northward, thence westward to California and Washington.

* * *Flowers white.*

+ *Peduncles shorter (sometimes longer in No. 3) than the leaves.*

3. *C. montanus*, Torr. & Gray. *Root long and fleshy: stem 2 to 6 inches high: leaves glaucous, ovate in outline, bipinnately divided; segments rather few and distant: involucre and involucel somewhat campanulate, scarious, about 5-parted: flowers polygamous: fruit with membranous wings; oil-tubes 4 on the commissure.* — Loc. cit. Colorado, northward and westward.

4. *C. glomeratus*, Raf. *Root thick and fusiform: stem 3 to 8 inches high: caudex bearing the leaves and peduncles at the summit: leaves on long petioles, ternately divided and bipinnatifid: leaflets of the palmately 5 to 7-parted involucre coherent at base and partly adnate to the rays of the umbellets: fruit with thickened and somewhat spongy wings; oil-tubes 3 to 4 in the intervals, about 8 on the commissure.* — Colorado and northward, also eastward along the Missouri and Arkansas Rivers.

5. *C. campestris*, Torr. & Gray. *Root tuberous: plant about 2 inches high: leaves 3-parted, the divisions remote, bipinnatifid: involucels minute: fruit with somewhat thickened and spongy wings, the alternate ones obsolete; oil-tubes 6 on the commissure.* — Loc. cit. "Plains of the Platte near the Rocky Mountains" (Nuttall).

+ + *Peduncles equalling the leaves or longer.*

6. *C. (?) anisatus*, Gray. *Acaulescent, cespitose from a much-branched caudex, glabrous: leaves narrow, on long petioles, somewhat rigid, pinnate; leaflets 6 to 10 pairs, pinnately parted; segments entire or laciniately lobed, linear, pungently acute: involucre usually none; involucels of 6 to 8 linear leaflets: fruit irregularly winged; calyx-teeth conspicuous; oil-tubes one in each narrow interval, 2 to 4 on the commissure.* — Proc. Acad. Philad. 1863, p. 63. Colorado, Nevada, and the Wasatch.

7. *C. bipinnatus*, Watson. *Cespitose, the short branches of the root-stock covered with the crowded remains of dead leaves, glaucous, rough-puberulent: leaves pinnate; leaflets 4 or 5 pairs, subequal, 3 to 5 lines long or less, pinnately divided; segments linear, entire or cleft into short linear lobes: scape 4 to 6 inches high, much exceeding the leaves: involucels of several linear-lanceolate leaflets: fruit nearly sessile, 1½ or 2 lines long; wings thin, but somewhat corky, narrow; oil-tubes 3 or 4 in the rather broad intervals.* — Proc. Am. Acad. xx. 368. *C. fœniculaceus* of Hayd. Rep. 1871. Resembling *C. alpinus*. Mountains of Montana, Hayden, Watson, Canby.

16. PEUCEDANUM, L.

Calyx-teeth obsolete or slightly prominent. Disk and stylopodium small and depressed. — Perennials, with fusiform or tuberous roots, caulescent or acaulescent: umbels mostly involucellate: leaves pinnate to decompositely dissected. — Watson, Proc. Am. Acad. xi. 121.

* *Leaves not finely dissected (rarely bipinnate), the segments large or broad or elongated: flowers yellow: fruit glabrous.*

+ *Acaulescent, glabrous: fruit oblong: leaves pinnate or bipinnate; leaflets narrowly linear.*

1. **P. graveolens**, Watson. *Scapæ 6 to 18 inches high, a little exceeding the leaves: fruit 4 or 5 lines long, narrowly margined: oil-tubes about 2 in the intervals, 4 on the commissure.* — Bot. King's Exp. 128. Mountains of Utah and Colorado, subalpine.

+ + *Caulescent: oil-tubes solitary: leaflets linear, entire.*

2. **P. simplex**, Nutt. *Finely puberulent, often tall: leaves ternate or biternate: fruit orbicular, 3 to 6 lines long, emarginate at each end; wings broader than the body; ribs prominent.* — From S. W. Montana to N. Arizona.

3. **P. ambiguum**, Nutt. *Glabrous, often low: leaves 1 to 2-pinnate with long leaflets, the upper often more dissected: fruit narrowly oblong, 4 lines long, narrowly winged; oil-tubes 2 on the commissure.* — Torr. & Gray, Fl. i. 626. W. Montana to Oregon and Washington. Root much used by the Indians.

* * *Leaves ample, very finely dissected with short filiform segments: flowers yellow: fruit glabrous.*

+ *Acaulescent, usually tomentose: fruit orbicular or broadly elliptical.*

4. **P. fœniculaceum**, Nutt. *Sometimes even glabrous: involuclæ gamophyllous, 5 to 7-cleft: fruit 2 or 3 lines in diameter; ribs prominent; oil-tubes 1 to 3 in the intervals, 2 to 4 on the commissure.* — Loc. cit. 627. From the Saskatchewan to Nebraska and the Indian Territory.

+ + *Caulescent, glabrous: fruit oblong.*

5. **P. bicolor**, Watson. *Stem short: peduncle elongated: rays few, very unequal: involuclæ of a few linear bractlets: fruit narrowing from near the base, narrowly winged; ribs filiform; oil-tubes obscure.* — Bot. King's Exp. 129. Wasatch Mountains.

* * * *Leaves smaller, much or finely dissected with small segments: flowers yellow: fruit pubescent: low, acaulescent.*

6. **P. villosum**, Nutt. *More or less densely pubescent: leaves of very numerous crowded narrow segments: umbels dense in flower: fruit oval, 3 or 4 lines long; oil-tubes several in the intervals.* — From Nebraska to W. Nevada and S. Utah.

* * * * *Leaves much dissected with small segments: flowers white: fruit glabrous: usually low, somewhat caulescent or scarcely so.*

7. **P. macrocarpum**, Nutt. *More or less pubescent: involuclæ conspicuous: fruit 4 to 10 lines long, 2 or 3 wide; calyx-teeth evident; ribs filiform; oil-tubes rarely 2 or 3 in the intervals, 2 to 4 on the commissure.* — Torr. & Gray, Fl. i. 627. From the Saskatchewan to Washington and N. California.

8. **P. nudicaule**, Nutt. *Nearly glabrous: involuclæ small: fruit elliptical, 2 or 3 lines long; calyx-teeth obsolete; ribs prominent; oil-tubes always solitary, 2 to 4 on the commissure.* — Loc. cit. Nebraska and N. Colorado.

17. **HERACLEUM**, L. COW PARSNIP.

Calyx-teeth small or obsolete. Disk undulate; stylopodium conical. Fruit orbicular or elliptical; oil-tubes 2 on the commissure: seed flat and thin.—Leaves ample, compound: umbels many-rayed: involucels many-leaved.

1. **H. lanatum**, Michx. A very large strong-scented plant, 4 to 8 feet high, woolly: stem grooved: leaves 1 to 2-ternately compound; leaflets somewhat heart-shaped.—From Colorado to British America and eastward to the Atlantic; also in California.

18. **ARCHEMORA**, DC. COWBANE.

Calyx 5-toothed. Fruit oval, flattish; ribs approximated and equidistant on the convex back; oil-tubes 4 to 6 on the commissure.—Leaves pinnate, with 3 to 9 lanceolate or linear leaflets: involucels of numerous small leaflets.

1. **A. Fendleri**, Gray. Root fasciculate-tuberosc; tubers 3 to 4, about an inch long: stem simple, 1 to 2 feet high: leaflets of the radical and lower cauline leaves ovate or oblong, all incisely serrate throughout: fruit hardly 2 lines long.—Pl. Fendl. 56. Colorado and New Mexico.

19. **FERULA**, L.

Calyx-teeth obsolete. Disk small and stylopodium depressed. Fruit oblong elliptical or nearly orbicular.—Smooth, nearly acaulescent perennials, with thick fusiform roots: leaves pinnately decomposed: flowers yellow, in many-rayed umbels.

1. **F. multifida**, Gray. Stems $1\frac{1}{2}$ to 2 feet high, stout, naked or with 1 or 2 leaves: segments of the 3 to 4-pinnate leaves incisely pinnatifid, with narrow or linear lobes: flowers dull yellow or brownish.—Proc. Am. Acad. vii. 348. In the Wasatch, W. Montana, Idaho, and Oregon.

20. **POLYTÆNIA**,¹ DC.

Calyx 5-toothed. Fruit oval, very flat; many oil-tubes in the corky margin.—A smooth herb, with 2-pinnate leaves, the uppermost opposite and 3-cleft. involucels bristly: flowers bright yellow.

1. **P. Nuttallii**, DC. Plant 2 or 3 feet high, with rather a stout sulcate stem which is usually scabrous and leafy: leaves mostly on long petioles, the segments pinnately incised or toothed: fruit 3 lines long, entire at each end.—Plains of the Platte and eastward to Indiana and Louisiana.

ORDER 37. **ARALIACEÆ**. (GINSENG FAMILY.)

Like *Umbelliferae*, but the umbels not regularly compound, stems apt to be woody, styles and carpels more than two, and the fruit fleshy (berry-like or drupaceous).

1. **Aralia**. Petals imbricated. Ovary 2 to 5-celled. Pedicels jointed. Ours not prickly.
2. **Fatsia**. Petals valvate. Ovary 2 to 3-celled. Pedicels not jointed. Very prickly throughout.

¹ The introduced *Daucus Carota*, L., may be known by its bristly stem, pinnatifid involucre which equals the dense and concave umbel, white or cream-colored flowers, the central one of each umbellet being abortive and dark purple.

1. **ARALIA**, L. SPIKENARD.

Calyx 5-toothed or entire. Petals 5, ovate. Stamens 5. Disk depressed or rarely conical. Ovary 2 to 5-celled: styles free or connate at base, at length divaricate. Fruit laterally compressed, becoming 3 to 5-angled. — Perennial herbs or shrubs: leaves alternate, digitate or compound, with serrate leaflets: umbels mostly simple, solitary, racemed or paniced.

1. **A. racemosa**, L. *Herbaceous: stem widely branched: leaves very large, quinately or pinnately decomposed; leaflets cordate-ovate, doubly serrate: umbels very numerous in a large compound panicle.* — Base of the Rocky Mountains, Dr. James, and from Canada to Georgia.

2. **A. nudicaulis**, L. *Stem somewhat woody, short, scarcely rising out of the ground, bearing a single long-stalked leaf and a shorter naked scape, with 2 to 7 umbels: leaflets oblong-ovate or oval, serrate, 5 on each of the 3 divisions.* — In the Rocky Mountains, and from Canada to the Southern States.

2. **FATSIA**, Dene. & Planch.

Woody plant, with very large leaves palmately lobed, and the capitate umbels in a long raceme.

1. **F. horrida**, Benth. & Hook. *Stem stout and woody, 6 to 12 feet long, creeping at base, leafy at the summit, and very prickly throughout, making the forests in places almost impassable.* — Cascade and Coast Ranges, from the Columbia northward, and extending into the Bitter Root Mountains.

ORDER 38. **CORNACEÆ**. (DOGWOOD FAMILY.)

Trees or shrubs, rarely herbs, with simple and entire mainly opposite leaves, no stipules, and flowers in cymes or involucre heads; petals and stamens 4 and epigynous; calyx adherent to the 1 to 2-celled ovary, which becomes a 1 to 2-seeded drupe or berry.

1. **CORNUS**, L. DOGWOOD. CORNEL.

Flowers perfect. Calyx minutely 4-toothed. Petals oblong or ovate, valvate. Style slender: stigma capitate or truncate. — Shrubs or perennial herbs: flowers white or greenish.

1. **C. Canadensis**, L. *Stems low and simple, 5 to 7 inches high, from a slender creeping trunk: leaves scarcely petioled, the upper crowded into an apparent whorl in sixes or fours, ovate or oval: flowers greenish, in a head or close cluster, which is surrounded by a large and showy, 4-leaved, corolla-like, white or rarely pinkish involucre: fruit bright red.* — Colorado and northward, thence eastward across the continent.

2. **C. stolonifera**, Michx. *Shrub 3 to 6 feet high; branches, especially the osier-like annual shoots, bright red-purple, smooth: leaves ovate, rounded at the base, abruptly short-pointed, roughish with a minute close straight pubescence on both sides, whitish underneath: flowers white, in open and flat spreading cymes: involucre none: fruit white or lead-color.* — *C. pubescens* of Fl. Colorado and King's and Hayden's Reports. Same range as the last.

DIVISION II. GAMOPETALÆ.

Perianth consisting of both calyx and corolla, the latter more or less gamopetalous, that is, with petals united.

ORDER 39. CAPRIFOLIACEÆ. (HONEYSUCKLE FAMILY.)

Shrubs, or rarely herbs, with opposite leaves, no stipules, the calyx-tube adnate to the 2 to 5-celled ovary, the stamens mostly as many as the lobes of the corolla and alternate with them, inserted on its tube or base. Flowers commonly 5-merous.

* Corolla regular, short, rotate or open-campanulate: style short or hardly any; stigmas 3 to 5: fruit baccate-drupeaceous: inflorescence terminal and cymose.

+ Herb, with stamens doubled and flowers in a capitate cluster.

1. **Adoxa.** Calyx with hemispherical tube adnate to above the middle of the ovary: limb about 3-toothed. Corolla rotate, 4 to 6-cleft. Stamens a pair below each sinus of the corolla, each with a peltate one-celled anther. Ovary 3 to 5-celled. Fruit greenish, maturing 2 to 5 cartilaginous nutlets.

+ + Shrubby to tree-like: stamens as many as corolla-lobes: inflorescence compound-cymose: anthers 2-celled: calyx 5-toothed.

2. **Sambucus.** Leaves pinnately compound. Corolla rotate or nearly so. Ovary 3 to 5-celled, forming small baccate drupes.

3. **Viburnum.** Leaves simple, sometimes lobed. Corolla rotate or open-campanulate. Ovary 1-celled and 1-ovuled, becoming a drupe.

* * Corolla commonly more or less irregular, elongated or at least campanulate: style elongated; stigma mostly capitate.

+ Herbaceous, creeping, with long-pedunculate geminate flowers and dry one-seeded fruit, but a 3-celled ovary.

4. **Linnæa.** Calyx with a 5-parted limb, constricted above the globular tube. Corolla campanulate-funnelform, almost equally 5-lobed. Stamens 4, didynamous, included. Style exserted.

+ + Shrubs, with scaly winter buds, erect or climbing: fruit two to many-seeded.

5. **Symphoricarpos.** Calyx with a globular tube and 4 to 5-toothed limb. Corolla regular, not gibbous, from short-campanulate to salverform, 4 to 5-lobed. Ovary 4-celled. Fruit a globose berry-like drupe, containing two small and seed-like bony nutlets.

6. **Lonicera.** Calyx with ovoid or globular tube and a short 5-toothed or truncate limb. Corolla from-campanulate to tubular, more or less gibbous at base; the limb irregular and commonly bilabiate, sometimes almost regular. Ovary 2 to 3-celled. Fruit a few to several-seeded berry.

1. **ADOXA**, L. MOSCHATEL.

An anomalous genus in this order. Cauline leaves a single pair: a very small herb, a span or less high, with musky odor.

1. **A. Moschatellina**, L. Glabrous and smooth: radical leaves once to thrice ternately compound; cauline pair of leaves 3-parted or of 3 obovate and 3-cleft or parted leaflets: flowers small, greenish-white or yellowish, 4 or

5 in a slender-pedunculate glomerule: corolla of the terminal one 4 to 5-cleft, of the others 5 to 6-cleft. — Subalpine, Arctic America to Colorado and eastward in the Northern States.

2. **SAMBUCUS**, TOURN. ELDER.

Plants with large pith to the vigorous shoots, serrate leaflets, small flowers in broad cymes, and red or black berry-like fruits. Stems with warty bark.

* *Compound cymes thyrsoid-paniculate; the axis continued and sending off several pairs of branches: pith of year-old shoots deep yellow-brown.*

1. **S. racemosa**, L. Stems 2 to 12 feet high; branches spreading: leaves from pubescent to nearly glabrous; leaflets 5 to 7, ovate-oblong to ovate-lanceolate, acuminate, thickly and sharply serrate: *thyrsiform cyme ovate or oblong*: flowers dull white, drying brownish: *fruit scarlet*. — *S. pubens*, Michx. In cool districts, across the continent.

2. **S. melanocarpa**, Gray. Glabrous, or young leaves slightly pubescent: leaflets 5 to 7, rarely 9: *cyme convex, as broad as high*: flowers white: *fruit black*, without bloom: otherwise much like preceding. — Proc. Am. Acad. xix. 76. Ravines of the Rocky Mountains of Montana to Oregon, and south to New Mexico and California.

* * *Compound cymes depressed, 5-rayed; external rays once to thrice 5-rayed: pith of year-old shoots bright white.*

3. **S. Canadensis**, L. Plants 5 to 10 feet high, glabrous, except some fine pubescence on midrib and veins of leaves beneath: leaflets (5 to 11) mostly 7, ovate-oval to oblong-lanceolate, acuminate, the lower not rarely bifid or with a lateral lobe; stipels not uncommon, narrowly linear, and tipped with a callous gland: *fruit dark purple, becoming black, with very little bloom*. — From the S. Rocky Mountains eastward to Canada and Florida.

3. **VIBURNUM**, L.

Shrubs or small trees, with tough and flexible branches, simple leaves, and terminal depressed cymes of white flowers. — In our species the drupes are light red, globose, acid and edible, with the stone very flat, orbicular, and even, and the leaves palmately veined.

1. **V. pauciflorum**, Pylaie. Glabrous or pubescent, 2 to 5 feet high, straggling: leaves of roundish or broadly oval outline, unequally dentate, many of them either obsoletely or distinctly 3-lobed, about 5-nerved at base: cymes small, terminating short and merely 2-leaved lateral branches, involucrate with slender subulate caducous bracts, destitute of neutral radiant flowers. — Mountains of Colorado, northward and eastward in cold or mountainous regions.

4. **LINNÆA**, GRONOV. TWIN-FLOWER.

A trailing and creeping evergreen, with filiform branches, purplish rose-colored sweet-scented flowers which are sometimes almost white.

1. **L. borealis**, Gronov. Somewhat pubescent: leaves obovate and rotund, $\frac{1}{2}$ to 1 inch long, crenately few-toothed, somewhat rugose-veiny, tapering into a short petiole: peduncles filiform, terminating ascending short leafy branches,

bearing at summit a pair of small bracts, and from axil of each a filiform one-flowered pedicel: pedicels similarly 2-bracteolate at summit, and a pair of larger ovate glandular-hairy inner bractlets subtending the ovary: flowers nodding. — From the mountains of California, Colorado, and Maryland, northward to the Arctic Circle.

5. SYMPHORICARPOS, Dill. SNOWBERRY. INDIAN CURRANT.

Low and branching shrubs, erect or diffuse, not climbing; with small and entire short-petioled leaves, and 2-bracteolate small white or pinkish flowers. — Fruit in ours white, and the style glabrous.

* *Short-flowered: corolla urceolate- or open-campanulate, only 2 or 3 lines long: flowers in terminal and upper axillary clusters, or solitary in some axils.*

1. **S. occidentalis**, Hook. *Robust, glabrous, or slightly pubescent: leaves oval or oblong, thickish (larger 2 inches long): axillary flower-clusters not rarely pedunculate, sometimes becoming spicate and an inch long: corolla 3 lines high, 5-cleft to beyond the middle, within densely villous-hirsute with long beard-like hairs: stamens and style more or less exerted.* — Mountains of Colorado and Montana, northward and eastward. “Wolf berry.”

2. **S. racemosus**, Michx. *More slender and glabrous: leaves round-oval to oblong, smaller: axillary clusters mostly few-flowered, or lowest one-flowered: corolla 2 lines high, 5-lobed above the middle, moderately villous-bearded within, narrowed at base: stamens and style not exerted.* — Across the continent. “Snowberry.”

Var. **pauciflorus**, Robbins. *Low, more spreading: leaves commonly only an inch long: flowers solitary in the axils of upper ones, few and loosely spicate in the terminal cluster.* — Mountains of Colorado to those of Oregon, Vermont, and northward.

* * *Longer-flowered: corolla from oblong-campanulate to salverform, 5-lobed only at summit, 4 to 6 lines long: flowers mostly axillary.*

3. **S. oreophilus**, Gray. *Glabrous or sometimes with soft pubescence: leaves oblong to broadly oval, $\frac{1}{2}$ to $\frac{3}{4}$ inch long: corolla tubular or funnelform, its tube almost glabrous within, 4 or 5 times the length of the lobes: nutlets of the drupe oblong, flattened, attenuate and pointed at base.* — Bot. Calif. i. 279. **S. montanus**, Gray. *Mountains of Colorado, Utah, and Arizona, to California and Oregon.*

6. LONICERA, L. HONEYSUCKLE. WOODBINE.

Erect or climbing shrubs; with leaves mostly entire, and the inflorescence various.

* *Flowers in pairs (or threes) from the axils of the leaves, the ovaries of the two either distinct or connate: stems erect and branching: corolla rather short.*

+ *Bracts at the summit of the peduncle very small, subulate: bractlets minute, rounded: berries red.*

1. **L. Utahensis**, Watson. *Leaves oval or elliptical-oblong, rounded at both ends, very short petioled, glabrous or nearly so from the first, or soon*

glabrate, reticulate-venulose at maturity, 1 or 2 inches long: peduncles seldom over a half-inch long: corolla honey-yellow or ochroleucous, occasionally tinged with purple, $\frac{3}{8}$ to $\frac{1}{2}$ inch long; the tube gibbous at base, pilose-pubescent within. — Bot. King's Exp. 133. Mountains of Utah, Montana, Oregon, and northward.

+ + *Bracts oblong to ovate or cordate and foliaceous; in fruit enlarging and enclosing or surrounding the two globose dark purple or black berries: bractlets conspicuous and accrescent.*

2. **L. involucrata**, Banks. Pubescent, sometimes glabrate, 2 to 10 feet high: leaves from ovate to oblong-lanceolate, 2 to 5 inches long, petioled: peduncles 1 or 2 inches long, sometimes 3-flowered: corolla yellowish, viscid-pubescent, a half-inch or more long: bractlets 4 or united into 2, viscid-pubescent. — Mountains of Colorado and California to Alaska, and extending eastward into Canada.

* * *Flowers in variously disposed terminal or axillary clusters, commonly verticillate: stems twining: uppermost pair or two of leaves connate into an oral or orbicular disk: corolla with more or less elongated tube: berries orange or red.*

3. **L. ciliosa**, Poir. Leaves ovate or oval, glaucous beneath, usually ciliate, otherwise glabrous: whorls of flowers single and terminal, or rarely 2 or 3, and occasionally from the axils of the penultimate pair of leaves, either sessile or short-peduncled: corolla glabrous or sparingly pilose-pubescent, yellow to crimson-scarlet; limb slightly bilabiate; lower lobe 3 or 4 lines long. — From the mountains of Arizona and California to those of Montana and British Columbia.

ORDER 40. RUBIACEÆ. (MADDER FAMILY.)

Shrubs or (ours) herbs, with opposite entire leaves connected by interposed stipules, or verticillate without apparent stipules, the calyx adnate to the 2 to 4-celled ovary, the stamens as many as the lobes of the regular corolla, and inserted on its tube.

* Leaves opposite, with entire interpetiolar stipules.

1. **Kelloggia**. Flowers generally 4-merous. Calyx with obovate tube and minute teeth. Corolla between funnelform and salverform. Stamens and style more or less exserted. Ovary 2-celled. Fruit small, dry and coriaceous, beset with hooked bristles, separating at maturity into 2 closed carpels.

* * Leaves verticillate, without stipules.

2. **Gallium**. Flowers 4-merous, sometimes diceious. Calyx with globular tube and obsolete limb. Corolla rotate; lobes commonly with inflexed acuminate or mucronate tip. Stamens with short filaments. Style 2-cleft or styles 2. Ovary 2-celled, 2-lobed. Fruit didymous, dry (in ours), jointed on the pedicel, separating into two closed carpels, or only one maturing.

1. KELLOGGIA, Torr.

A single Californian species, most nearly allied in our flora to *Mitchella*.

1. **K. galioides**, Torr. Slender and glabrous or puberulent perennial, a span to a foot high: leaves opposite, lanceolate, sessile, with small and en-

tire or 2-dentate interposed stipules: fruit and paniculate inflorescence as in *Galium*: corolla white or pinkish, 2 or 3 lines long. — Mountain woods, mostly under coniferous trees, California and Arizona to Washington and N. W. Wyoming.

2. GALIUM, L. BEDSTRAW. CLEAVERS.

Herbs (occasionally with suffrutescent base) with sessile leaves and small flowers variously arranged.

* *Woody at base: leaves 4 in the whorls; their margins, midrib, and angles of stem destitute of retrorse hispidness or roughness: fruit hirsute with long and straight (not at all hooked) bristles: flowers diœcious: stems low and diffuse.*

1. *G. Matthewsii*, Gray. Glabrous and smooth, paniculately much branched, woody at base: leaves rigid, lanceolate to ovate-lanceolate, veinless, with stout midrib, 2 or 3 lines long or more, some of the upper cuspidate-acute: flowers (of fertile plant) naked-paniculate: corolla barely a line in diameter: bristles of immature fruit rigid, not longer than the body. — Proc. Am. Acad. xix. 80. S. W. Colorado, New Mexico, and E. California.

* * *Wholly herbaceous: margins and midribs of the leaves and angles of the stem often retrorse hispid or rough: bristles on the fruit more or less hooked or none: flowers not diœcious.*

+ *Fruit beset with hooked bristles: leaves 6 or 8 in a whorl.*

2. *G. Aparine*, L. Stems 1 to 4 feet long, retrorsely hispid on the angles, as also on the margins and midrib of the oblanceolate or almost linear cuspidate-acuminate leaves: peduncles rather long, 1 to 3 in upper axils or terminal, bearing either solitary or 2 or 3 pedicellate white flowers: fruit not pendulous, granulate-tuberculate and the tubercles tipped with bristles. — From Texas to California and northward; eastward mainly as an introduced plant.

Var. *Vaillantii*, Koch. Smaller, more slender: leaves seldom an inch long: flowers usually more numerous: fruit smaller, hirsute or hispidulous. — Texas to California, Montana, and British Columbia.

3. *G. triflorum*, Michx. *Diffusely procumbent, smoothish*: herbage sweet-scented in drying: stems a foot to a yard long: leaves in sixes, elliptical-lanceolate to narrowly oblong (inch or two long), scabrous or not on the margins and midrib beneath: cymes once or twice 3-rayed: pedicels soon divaricate: corolla yellowish white to greenish, its lobes hardly surpassing the bristles of the ovary. — Across the continent.

+ + *Fruit without hooked bristles: leaves 4 to 6 in a whorl.*

+ + *Flowers very numerous and collected in a terminal and ample thyrsiform panicle: leaves in fours, 3-nerved, blunt.*

4. *G. boreale*, L. Erect, a foot or two high, mostly smooth and glabrous, very leafy: leaves from linear to broadly lanceolate, often with fascicles of smaller ones in the axils: flowers in a terminal panicle; the uppermost leaves being reduced to pairs of small oblong or oval bracts: fruit small, hispidulous, or at first canescent and soon glabrous and smooth. — From New Mexico and California north to Arctic regions and east to Canada.

++ ++ *Flowers few in number and scattered.*

5. **G. bifolium**, Watson. Smooth and glabrous, a span or two high, sparingly branched, slender: leaves oblanceolate to nearly linear, 4 in the whorls, the alternate ones smaller, or uppermost nearly reduced to a single pair: flowers on solitary naked peduncles: fructiferous peduncles about the length of the leaves, horizontal, and the minutely hispidulous fruit decurved on the naked tip. — Bot. King Exp. 134. Mountains of W. Colorado and S. Montana to California.

6. **G. trifidum**, L. Weakly erect, branching, 5 to 20 inches high, smooth and glabrous, except the retrorsely scabrous angles of the stem and usually more hispidulous and sparse roughness of the midrib beneath and margins of the leaves: these in sixes, fives, or not rarely fours, linear or oblanceolate, or lanceolate-oblong, obtuse, 4 to 7 lines long: peduncles slender, scattered, one to several-flowered; flowers often 3-merous, as commonly 4-merous: fruit smooth and glabrous. — From Texas to California, northward and eastward.

Var. **pusillum**, Gray, is the smallest form, a span or two high: leaves only in fours, 3 or 4 lines long narrow, in age often reflexed: peduncles 1-flowered. — In the mountains of Colorado and California, and northward.

Var. **latifolium**, Torr. The larger and broadest-leaved form: leaves 6 or 7 lines long, often 2 lines wide: cymules few to several-flowered. — Canada to Texas and California.

ORDER 41. VALERIANACEÆ. (VALERIAN FAMILY.)

Herbs with opposite leaves and no stipules, the calyx-tube adnate to the ovary, which has one fertile one-ovuled cell and two abortive or empty ones, stamens 1 to 3, distinct, fewer than the lobes of the corolla and inserted on its tube. — Corolla tubular or funnelform, mostly 5-lobed: flowers in terminal cymes.

1. VALERIANA, Tourn.

Calyx-limb of 5 to 15 setiform lobes, which are inrolled and inconspicuous until fruiting. Stamens 3. Roots of peculiar scent. Leaves various. Flowers white or rose-colored.

* *Erect from a large fusiform perpendicular stock branching below into deep and thickened roots: leaves thickish, nervosely veined, not serrate.*

1. **V. edulis**, Nutt. Glabrous or glabrate, a foot or at length 3 feet or more high: radical leaves oblanceolate to spatulate, tapering into a margined petiole, entire or some sparingly lacinate-pinnatifid; cauline rarely none, commonly 1 to 3 pairs, sessile, and pinnately parted into 3 to 7 linear or lanceolate divisions, or terminal one spatulate: flowers polygamo-dioecious, yellowish white, sessile in the cymules, which form an elongated thyrsiform naked panicle. — Mountains of New Mexico and Arizona, northward and eastward.

* * *Erect from creeping or ascending rootstocks, which emit slender roots: leaves thinnish, loosely veiny, often with some simple and some divided and margins either entire or dentate on same plant; the radical ones on slender naked petioles: corolla white to light rose-color.*

2. **V. sylvatica**, Banks. Stems from 8 to 30 inches high: radical leaves mostly simple and ovate to oblong, occasionally some 3 to 5-foliolate; cauline more or less petioled, 3 to 11-foliolate or parted, the divisions entire or rarely few-toothed: *fruiting cymes open*, at length thyrsoid-paniculate: *corolla 2 or 3 lines long*. — *V. dioica*, var. *sylvatica*, Gray. Mountains of New Mexico and Arizona, northward and eastward.

3. **V. Sitchensis**, Bong. *More robust*, from thicker and branching ascending rootstocks: *leaves larger*; cauline short-petioled, *only 3 to 5-foliolate*; the divisions orbicular to oblong-ovate, or in the upper leaves ovate-lanceolate, not rarely dentate or repand: *cymes contracted*: *corolla funnelform, 4 lines long*. — Northern Rocky Mountains and northward.

ORDER 42. COMPOSITÆ. (COMPOSITE FAMILY.)

Flowers in a close head on a common receptacle, surrounded by an involucre, with (5 or 4) stamens inserted on the corolla, their anthers united in a tube. — Calyx-tube adnate to the 1-celled ovary, the limb (*pappus*) crowning its summit in the form of bristles, awns, scales, etc., or even absent. Corolla strap-shaped (*ligulate*) or tubular. Style 2-cleft. Fruit an akene. — The flowers are perfect, monœcious, diœcious, or polygamous. Strap-shaped marginal flowers are the *rays*; heads with prominent rays and tubular flowers are *radiate*; and a head composed entirely of strap-shaped corollas is *ligulate*. The tubular flowers compose the *disk*, and a head with no rays is *discoïd*. A head with all its flowers alike as to sex is *homogamous*, when unlike *heterogamous*. The leaves of the involucre are *scales*; and the bracts or scales which are often found upon the receptacle among the flowers are *chaff*, and when this is wanting the receptacle is *naked*.

Key to the Tribes.

Ser. I. TUBULIFLORÆ. Corollas tubular and regular in all the hermaphrodite flowers.

Heads homogamous and discoïd: flowers all hermaphrodite and never yellow: anthers not caudate at base.

Style-branches elongated, filiform-subulate, hispidulous throughout; stigmatic lines only near the base: leaves alternate. I. VERNONIACÆ.

Style-branches elongated, more or less clavate-thickened upward and obtuse, minutely papillose-puberulent, stigmatic only below the middle.

II. EUPATORIACÆ

Heads homogamous or heterogamous, discoid or radiate: flowers not rarely yellow: style-branches of hermaphrodite flowers with stigmatic lines extending either to the naked summit or to a more or less distinct pubescent or hispidulous tip or appendage.

Anthers not caudate at base: style-branches in hermaphrodite flowers flattened and with a distinct (but sometimes very short) terminal appendage: disk-corollas generally yellow: rays of same or different color.

III. ASTEROIDEÆ.

Anthers caudate: style-branches of hermaphrodite flowers slender, destitute of any terminal appendage, the stigmatic lines extending quite to (or vanishing near) the naked obtuse or truncate summit: leaves alternate: heads in our genera discoid. IV. INULOIDEÆ.

Anthers not caudate: style-branches with truncate or variously appendiculate pubescent or hispid tips: involucre not scarious: receptacle chaffy: pappus various or none, never of fine capillary bristles.

V. HELIANTHOIDEÆ.

Anthers not caudate: receptacle naked: pappus from chaffy to setiform or none: herbage often punctate with resinous or pellucid dots or glands: otherwise nearly as preceding. VI. HELENIOIDEÆ.

Anthers not caudate: receptacle naked or sometimes chaffy: involucre of dry and scarious bracts: style-branches mostly truncate: pappus coroniform, or of short scales, or none. VII. ANTHEMIDEÆ.

Anthers not caudate: receptacle naked: involucre little or not at all imbricated, not scarious. Pappus of numerous soft-capillary bristles.

VIII. SENECTIONIDEÆ.

Anthers conspicuously caudate, and with elongated appendages at tip: style-branches short or united, destitute of appendage, stigmatic quite to the obtuse summit, mostly smooth and naked: involucre much imbricated: receptacle densely setose or fimbriate, or favose: akenes thick and hard: pappus usually plurisetose. Heads never truly radiate.

IX. CYNAROIDEÆ.

Ser. II. **LIGULIFLORÆ.** Corollas all ligulate and flowers hermaphrodite.

Receptacle naked or chaffy: anthers not caudate: style-branches filiform, naked, stigmatic only toward the base. Herbage with milky juice.

X. CICHORIACEÆ.

Tribe I. VERNONIACEÆ. Corollas tubular, 5-lobed.

1. **Vernonia.** Heads several to many-flowered. Involucre of dry or partly herbaceous much imbricated bracts. Receptacle plane, naked. Corolla regularly 5-cleft into narrow lobes. Akenes mostly 10-costate, with truncate apex. Pappus double; the inner of rigid capillary bristles, outer a series of small scales.

Tribe II. EUPATORIACEÆ. Receptacle in most cases naked. Leaves either opposite or alternate.

- * Akenes 5-angled: scales of the involucre mostly lax, from thin-membranaceous to herbaceous, nerveless or few-nerved, either imbricated or equal and about in one row.
- 2. **Eupatorium.** Heads few to many-flowered. Receptacle flat. Pappus wholly of scabrous capillary bristles which are mostly in one row, and indefinitely numerous.

- * * Akenes 10-costate or striate : scales of the involucre regularly imbricated ; the outer ones successively shorter.
- ← Scales of the involucre not herbaceous, conspicuously striate-nerved : corolla slender, 5-toothed at summit ; the teeth mostly glandular : pappus a single series of bristles : leaves mostly not entire.
- 3. **Kuhnia**. Pappus conspicuously plumose. Scales of the involucre narrow, in few series. Leaves nearly all alternate.
- 4. **Brickellia**. Pappus from barbellate or subplumose to merely scabrous. Leaves opposite or alternate.
- ← ← Scales of the involucre somewhat herbaceous or partly colored, not conspicuously striate : corollas narrow, with gradually dilated throat and elongated lanceolate or linear spreading (rose-colored) lobes : pappus about a single series of capillary or stouter bristles : leaves punctate, entire.
- 5. **Liatris**. Heads few to many-flowered. Involucre spirally imbricate. Akenes slender or tapering from apex to base, pubescent. Pappus of firm and mostly equal bristles, from plumose to barbellate. Leaves alternate. Herbs, with heads in a terminal spike or raceme, sometimes becoming paniculate.

Tribe III. ASTEROIDEÆ. Heads with ligulate ray-flowers pistillate or rarely neutral, or with the flowers all hermaphrodite and tubular, or even dioecious. Receptacle seldom chaffy. Pappus various, sometimes none. Leaves mostly alternate.

- * Disk wholly of hermaphrodite flowers, of the same color as the ray (if present), mostly yellow ; their corollas tubular with more or less ampliate throat and 4 or 5-lobed limb : receptacle not chaffy, flat or merely convex : involucre closely imbricated, mostly in several series.
- ← Pappus chaffy : heads radiate, small, paniculate or cymose-clustered : scales of the involucre mostly coriaceous, the outer successively shorter.
- 6. **Gutierrezia**. Involucre oblong-clavate or turbinate to campanulate. Receptacle from flat to conical, commonly alveolate or limbrillate. Style-appendages mostly slender. Rays 1 to 8. Akenes short, obovate or oblong, terete or 5-angled.
- ← ← Pappus of a few (2 to 8) elongated awns or rigid caducous bristles : heads radiate or rayless, solitary at the end of the branches.
- 7. **Grindelia**. Heads many-flowered, hemispherical or at first globose : the scales numerous and narrow, imbricated in many series, firm and rigid, with more or less herbaceous tips. Style-appendages lanceolate or linear. Akenes short and thick, compressed or turgid, or the outer triangular, truncate, glabrous.
- ← ← ← Pappus double : the inner of numerous capillary scabrous bristles : the outer, composed of minute short bristles or scales, which are sometimes even obsolete : heads mostly radiate, middle-sized, terminating the stem and branches.
- 8. **Chrysopsis**. Heads many-flowered, with rays numerous or wanting. Involucre campanulate or hemispherical, of narrow regularly imbricated scales. Style-appendages from linear-filiform to slender-subulate. Akenes from obovate to linear-fusiform, compressed or turgid.
- ← ← ← Pappus of numerous capillary scabrous bristles, simple, in one or more series : receptacle more or less alveolate and the alveoli often dentate : style-appendages from ovate-lanceolate to filiform : flowers yellow.
- 8. **Chrysopsis**. Species with outer pappus obscure or wanting would be sought here.
- 9. **Aplopappus**. Heads usually many-flowered, radiate, rarely discoid. Disk-corollas narrow, 5-toothed. Involucre usually (but not always) broad : the bracts with or without herbaceous tips. Akenes from turbinate to linear.
- 10. **Bigelovia**. Heads 3 to 30-flowered, destitute of rays, small. Involucre narrow : the bracts chartaceous or coriaceous, mostly destitute of foliaceous or herbaceous tips. Akenes narrow, terete or angled, hardly compressed, mostly at least 5-nerved. Pappus of somewhat equal bristles. Inflorescence not racemiform.

11. **Solidago.** Heads few- or several-, rarely many-flowered ; mostly radiate, small, commonly in racemiform or spiciform clusters, sometimes fastigiate-cymose or in a thyrsus. Involucre narrow : its bracts mostly not herbaceous-tipped. Akenes terete or angulate, 5 to 12-nerved or costate. Pappus of equal elongated bristles.
- * * Disk of hermaphrodite and mostly fertile flowers ; their corollas mostly yellow : the ray not yellow, occasionally wanting : receptacle naked, flat or barely convex.
- ← Pappus a single series of long awns or of coarse and rigid bristles, or in the conspicuous ray chaffy.
12. **Townsendia.** Involucre broad, many-flowered, imbricated : the bracts lanceolate, with scarious margins and tips, outer usually shorter and inner more membranaceous. Receptacle broad. Style-appendages lanceolate. Akenes obovate or oblong, much compressed, and with thickish margins, those of the ray sometimes triangular. Awns or bristles of the pappus scabrous.
- ← ← Pappus of numerous capillary bristles, with or without a short outer series.
13. **Aster.** Involucre from hemispherical to campanulate, sometimes oblong or turbinate, imbricated in several or few series of unequal bracts, mostly in part herbaceous. Rays numerous, not very narrow. Style-appendages from slender-subulate to ovate-acute, commonly lanceolate. Akenes mostly compressed, 2 to 10-nerved, and the pappus mostly simple and copious, rarely distinctly double. Leafy-stemmed herbs, the greater part perennials.
14. **Erigeron.** Differs from *Aster* in the more naked-pedunculate heads, simpler involucre of narrow and erect equal bracts, which are never coriaceous, nor foliaceous or with distinct herbaceous tips, narrower and usually very numerous rays often occupying more than one series, very short and roundish style-appendages, small 2-nerved akenes, and more scanty or fragile pappus, in many with a conspicuous short outer series.
- ← ← ← Corolla of the numerous female flowers reduced to a filiform or short and narrow tube, wholly destitute of ligule.
15. **Conyza.** Heads small, many-flowered. Bracts of the campanulate involucre narrow, in 1 to 3 series. Female flowers much more numerous than the hermaphrodite ; their filiform or slender tubular corolla truncate or 2 to 4-toothed at the apex. Pappus a single series of soft capillary bristles, sometimes an added outer series of short bristles.
- * * * Heads discoid and unisexual : corolla of the fertile flowers filiform : pappus of capillary bristles.
16. **Baccharis.** Heads completely diceious, many-flowered. Involucre regularly imbricated. Receptacle mostly flat and naked, rarely chaffy. Flowers of the male heads with tubular-funnelform 5-cleft corolla : the female with corolla reduced to a slender truncate or minutely toothed tube. Akenes 5 to 10-costate. Pappus of the male flowers a series of scabrous and often tortuous bristles : of the fertile flowers of usually more numerous and fine bristles, and often elongated in fruit. Shrubby or herbaceous.

Tribe IV. INULOIDEÆ. Female flowers ligulate or filiform. Style-branches filiform or flattish. Pappus capillary or none. Involucre commonly dry or scarious. Ours do not have conspicuous rays, and are all floccose-wooly herbs.

- * Involucre of few scarious bracts : receptacle chaffy ; a bract subtending each female flower or akene : anthers sometimes only acutely sagittate or auriculate : the short style or style-branches not truncate.
17. **Evax.** Akenes from obcompressed to terete, sometimes minutely papillose or puberulent. Bracts of the female flowers from scarious to chartaceous. Hermaphrodite flowers sometimes fertile, destitute of pappus. Receptacle from barely convex to subulate.
- * * Involucre of numerous more or less scarious bracts which are often colored or petaloid at the summit : receptacle not chaffy : anther-tails slender : style or style-branches mostly truncate.
18. **Antennaria.** Heads diceious, many-flowered. Involucre imbricated in many series. Male flowers with mostly undivided style and a rather scanty pappus of clavellate

or apically barbellulate or crisped bristles. Female flowers with oblong or narrower and terete or flattish akenes, and a copious fine-capillary pappus, the soft and naked bristles of which are commonly united at base, so as to fall in a ring. Low perennials.

19. **Anaphalls.** Heads dioecious, but usually with a few hermaphrodite sterile flowers in the centre of the female heads. Pappus of male flowers of bristles little if at all thicker at the apex: of the female flowers not united at base but falling separately. Otherwise as in the preceding; the female plant differing from the following only in the sterility of the few central flowers.
20. **Gnaphalium.** Heads heterogamous, fertile throughout, of few or many series of female surrounding a smaller number of hermaphrodite flowers. Involucre imbricated in many series: the scarious and commonly partly woolly bracts with or without colored papery tips or appendages. Style of hermaphrodite flowers 2-cleft. Pappus of numerous merely scabrous capillary bristles, in a single series.

Tribe V. HELIANTHOIDEÆ. Female flowers ligulate and radiate, or the heads sometimes homogamous by their absence: disk-flowers all with regularly 4 to 5-toothed corolla. Leaves mostly opposite.

- * Ray-flowers ligulate and fertile, the ligule mostly deciduous; disk-flowers hermaphrodite-sterile: akenes usually coriaceous; the style mostly entire: receptacle chaffy throughout, except in No. 24.
- + Involucre double; exterior of 4 or 5 herbaceous or foliaceous plane bracts; interior of a single series of small bracts, which completely and permanently enclose the obovate or oblong more or less compressed smooth and glabrous akenes with a pericarp-like accessory covering, at length deciduous together: pappus none.
- 21. **Melampodium.** Fructiferous bracts commonly indurated, naked or unarmed. Receptacle convex or conical. Akenes more or less obovate and incurved.
- + + Involucre broad, of plane or barely concave bracts; innermost subtending obcompressed (mostly much flattened) akenes, but not enclosing nor embracing them.
- + + Ray-flowers and akenes in more than one series, and with elongated exerted deciduous ligules: the akenes falling free, or with only the subtending bract.
- 22. **Silphium.** Heads large, many-flowered. Involucre of thickish more or less foliaceous imbricated bracts; the innermost small and chaffy. Receptacle comparatively small, the central part somewhat turbinate in age: its chaffy bracts linear, flat, or involute around the abortive ovaries. Corollas of the ray with a long and spreading ligule on a very short tube; of the disk cylindrical-tubular. Akenes very flat and broad, imbricated in 2 or 3 series, completely free from the subtending bract and from those of adjacent male flowers, surrounded by a winged margin which is produced more or less beyond the summit on each side into a callous tooth or auricle. Pappus none or sometimes a pair of short rigid awns or teeth, with which the wing is confluent united.
- + + Ray-flowers and akenes in a single series, with very short or even obsolete ligules: akenes with 2 or 3 bracts of sterile flowers attached to their base on the inner side, which they take with them, and commonly also the subtending involucre bract, when they fall: heads small.
- 23. **Parthenium.** Fertile flowers 5, with obcordate or 2-lobed almost sessile concave ligule, or a truncate emarginate cup. Bracts of the involucre chartaceous or partly herbaceous, and the inner more scarious: those of the usually conical receptacle cuneate, tomentose at summit, partly enclosing the sterile flowers. Akenes oval or obovate, commonly pubescent, surrounded by a filiform callous margin, which is firmly coherent at base with the bases of the bracts of the contiguous pair of sterile flowers and of the subtending bract, at length tearing away from the akene; the summit bearing the marcescent corolla. Pappus of two chaffy awns or scales, or sometimes hardly any.
- 24. **Parthenice.** Fertile flowers 6 to 8, with ligule obsolete or reduced to 2 or 3 small teeth: sterile flowers 40 or 50, with funnelliform corolla. Involucre of 5 somewhat herbaceous oval exterior bracts, and of 6 or 8 somewhat larger orbicular-obovate and

more scarious interior ones, these subtending the fertile flowers. Receptacle convex, with linear-oblong or spatulate chaffy bracts subtending the outer series of sterile flowers, but mostly minute or wanting to the inner flowers. Akenes oblong-obovate, glabrous, wingless, but acute-margined, with an incurved apiculation inserted by a very small base, falling away at maturity with the involucre and two receptacular bracts, but these readily separating. Pappus none, and corolla deciduous.

- * * Fertile flowers apetalous, or with corolla reduced to a tube or ring around the base of the 2-parted style ; disk-flowers staminate, anthers slightly united and their short terminal appendage inflexed, the abortive style hairy only at the somewhat enlarged and depressed summit, the ovary a mere rudiment : pappus none (or a vestige in Nos. 26 and 27) : heads small ; the flowers whitish or greenish.

← Head androgynous (rarely all male in No. 27), having few female flowers at the margin ; the more numerous male flowers all or most of them subtended by slender and commonly spatulate chaffy bracts : involucre open.

++ Akenes turgid, mostly obovate or pyriform, marginless.

- 25. **Iva.** Female flowers 1 to 5, with or without the tube or cup representing a corolla. Akenes more or less obcompressed, glabrous, puberulent, or glandular : the terminal areola small.

- 26. **Oxytenia.** Female flowers about 5, wholly destitute of corolla. Involucre of about 5 dilated-ovate and rather rigidly acuminate bracts. Receptacle convex, small : the 10 to 20 sterile flowers subtended by slender chaffy bracts with cuneate-dilated tips. Akenes (immature) very villous, nearly pyriform, with large terminal areola bearing around the base of the style a fleshy annular disk. Lower part of the disk-flowers and their chaff beset with some villous hairs.

++ ++ Akenes flattened, obcompressed, wing-margined.

- 27. **Dicoria.** Female flowers one or two, wholly destitute of corolla : male flowers 6 to 12, with mere rudiments of ovary and style. Involucre of 5 oval or oblong herbaceous bracts ; and within one or two larger and broad thin-scarious bracts, subtending the fertile flowers, or these wanting in male heads. Receptacle small, flat, with a few narrow and hyaline chaffy bracts. Filaments monadelphous up to the lightly connected anthers. Akenes much surpassing the outer involucre, oblong, anteriorly flat, convex or somewhat angled dorsally, abruptly bordered by a thin-scarious pectinate-dentate wing or edge. Pappus rudimentary, of several small and setiform bracts.

← ← Heads unisexual, monœcious ; the fertile with solitary or 2 to 4 completely or nearly apetalous female flowers in a closed nutlet-like or bur-like involucre, only the style-branches ever exerted ; the sterile of numerous male flowers in an open involucre, the heads in a raceme or spike : akenes turgid-obovoid or ovoid, wholly destitute of pappus : flowers greenish or yellowish.

++ Involucre of the sterile heads gamophyllous : the receptacle low, and abortive style with dilated apex radiately fimbriate.

- 28. **Ambrosia.** Involucre of the male flowers from depressed-hemispherical to turbinate, 5 to 12-lobed or truncate, herbaceous. Receptacle flat or flattish, usually with some filiform chaff among the outer flowers. Involucre to the solitary fertile flower nut-like, apiculate or beaked at the apex, and usually armed with 4 to 8 tubercles or short spines in a single series below the beak. Sterile heads spicate or racemose above the fewer fertile ones.

- 29. **Franseria.** Heads of male flowers as *Ambrosia*, or sometimes intermixed with the female. Fertile involucre 1 to 4-flowered, 1 to 4-celled, a single pistil to each cell, 1 to 4-rostrate, more or less bur-like, being armed over the surface with several or numerous prickles or spines (the spiny free tips of component bracts) in more than one series. Leaves mostly alternate.

++ ++ Involucre of the sterile heads polyphyllous : the receptacle cylindraceous.

- 30. **Xanthium.** Involucre of the globular sterile heads one or two series of small narrow bracts : receptacle distinctly chaffy, a cuneate or linear-spatulate chaffy bract partly enclosing each male flower : filaments monadelphous. Fertile heads a closed and ovoid bur-like 2-celled and 2-flowered involucre, 1 to 2-beaked at the apex, the surface

clothed with uncinatc-tipped prickles: each flower a single pistil, maturing a thick ovoid akeno, the two permanently enclosed in the indurated prickly involucre. Leaves alternate.

* * * Ray-flowers ligulate and fertile; the ligule with very short tube or none, persistent on the akeno and becoming papery in texture: disk-flowers hermaphrodite and fertile, numerous, subtended or embraced by chaffy bracts; the corolla cylindraceous: leaves opposite and heads singly terminating the stem or branches.

+ Leaves all or mostly entire, sessile: akenes of the disk compressed, all or some of them toothed or awned from the summit of the angles or edges.

31. **Zinnia.** Involucre campanulate or cylindraceous: its closely appressed-imbricated bracts dry and firm, broad, with rounded summit often margined. Receptacle becoming conical or cylindraceous: the chaffy bracts conduplicate around the disk-flowers. Lobes of the disk-corolla mostly velvety-villous. Pappus when present of erect awns or chaffy teeth. Rays showy.

+ + Leaves commonly serrate, slender-petioled: akenes not compressed.

32. **Heliosis.** Involucre short, of nearly equal oblong or lanceolate bracts. Receptacle from high-convex to conical: the pointless chaffy bracts partly embracing the disk-flowers. Ligules large: disk-corollas glabrous. Akenes obtusely 4-angular, with broad truncate summit, wholly destitute of pappus.

* * * * Ray-flowers ligulate and either fertile or neutral, or even wanting, the ligule not persistent: disk-flowers hermaphrodite and fertile, subtended and sometimes enwrapped by the chaff: pappus a cup or crown, of teeth or awns from the 2 to 4 principal angles, or of a few stout bristles, or none.

+ Receptacle high, from conical to columnar or subulate, at least in fruit.

33. **Echinacea.** Involucre imbricated in 2 or 3 or more series: its bracts lanceolate. Disk at first only convex, becoming ovoid and the receptacle acutely conical: chaffy bracts of the latter persistent, carinate-concave, acuminate into a rigid and spinescent cusp. Ligules rose-colored or rose-purple. Disk-corollas cylindraceous, with 5 erect teeth and almost no proper tube. Akenes acutely quadrangular, somewhat obpyramidal, with a thick coroniiform pappus more or less extended in 6 triangular teeth at the angles.

34. **Rudbeckia.** Involucre looser, spreading, more foliaceous. Disk from hemispherical or globose to columnar, and receptacle from acutely conical to cylindrical: its chaffy bracts not spinescent, but sometimes soft-pointed. Ligules yellow or partly brown-purple. Disk-corollas with a short but usually a manifest proper tube. Akenes 4-angled, prismatic. Pappus a coriaceous and often 4-toothed crown, sometimes none.

35. **Lepachys.** Akenes short and broad, compressed, acutely margined or sometimes winged at one or both edges, on a slender-subulate receptacle. Pappus a chaffy tooth over one or both edges, or none. Chaffy bracts of the receptacle conduplicate, with thickened and truncate summit, embracing and hardly surpassing the akenes, at length deciduous with them. Corollas of the disk with hardly any proper tube. Ligules, involucre, &c. of *Rudbeckia*.

+ + Receptacle from flat to convex, or in certain species conical: akenes not winged nor very flat, when flattened not margined or sharp-edged.

+ + Rays fertile: receptacle flat or merely convex: ray akenes commonly triquetrous or obcompressed: pappus persistent or none.

36. **Balsamorhiza.** Akenes destitute of pappus, oblong: of the disk quadrangular and often with intermediate nerves. Involucre broad: the outer bracts foliaceous, sometimes enlarged. Chaff linear-lanceolate. Tuberous-rooted low herbs.

37. **Wyethia.** Akenes prismatic, large, 4-angled, or in the ray 3-angled and in the disk often flattened, also with intermediate salient nerves. Pappus a lacerate chaffy crown, or cut into nearly distinct scales, commonly produced at one or more of the angles into chaffy rigid awns or teeth. Involucre campanulate or broader, more or less imbricated: outer bracts often foliaceous. Chaff lanceolate or linear, partly embracing the akenes. Thick-rooted and large-headed herbs, with alternate leaves.

++ ++ Rays sterile, rarely wanting: akenes quadrangular-compressed or more turgid: chaffy bracts of the convex or conical receptacle embracing the akenes.

33. **Gymnolomia.** Pappus none or a minute denticulate ring: the truncate apex of the short akenes commonly at length covered by the base of the corolla, the tube of which is usually pubescent.

39. **Helianthus.** Pappus deciduous, of two scarious and pointed scales, mostly no intermediate ones. Akenes usually glabrous or glabrate. Tube of the disk-corollas short, and the throat elongated.

+ + + Receptacle flat, convex, or sometimes becoming conical: akenes of the disk either flat-compressed and margined or thin-edged, or if turgid some of them winged: pappus not caducous.

40. **Hellanthella.** Rays neutral, rarely wanting. Pappus of delicate scales between the two chaffy teeth or awns which surmount the two acute margins of the akene, or these obsolete in age. Ovary often wing-margined, but mature akene not so.

41. **Verbesina.** Involucre campanulate or hemispherical, imbricated. Rays fertile, sometimes neutral or none. Akenes usually winged and flat, 2-awned, or in the ray 1 to 3-awned, with no intermediate scales, and even the awns sometimes wanting. Leaves apt to be decurrent as wings on the stem.

***** Akenes obcompressed or sometimes terete, and the subtending chaffy bracts flat or hardly concave; otherwise as in the last section: heads many-flowered: leaves mostly opposite: style-tips of the disk-flowers produced into a cusp or cone: involucre double: receptacle flat or merely convex: rays in ours neutral.

+ Akenes never with retrorsely barbed awns.

42. **Coreopsis.** Involucre of two distinct series of bracts, all commonly united at the very base; outer foliaceous, narrower, and usually spreading; inner erect or incurved after blooming, each series commonly 8 in number. Rays about 8. Akenes flat, orbicular to linear-oblong, winged or wingless, truncate or emarginate at summit, bearing 2, rarely 3 or 4 naked awns, scales, or teeth, or sometimes destitute of pappus.

+ + Awns of the pappus when present retrorsely barbed or hispid.

43. **Bidens.** Bracts of the involucre distinct, or united only at the common base. Akenes neither winged nor beaked, 2 to 5-awned: the awns retrorsely hispid. Rays neutral, yellow or white, sometimes wanting.

44. **Thelesperma.** Bracts of the inner involucre united into a cup: outer of shorter and narrow bracts, connate at base with the inner. Chaff of the flat receptacle white-scarious. Rays about 8, cuneate-obovate. Disk-corollas with long and slender tube, and abrupt campanulate or cylindrical throat. Anthers wholly exerted. Akenes slightly obcompressed or terete, narrowly oblong to linear, marginless, beakless: the abrupt summit crowned with a pair of persistent and stout awns or scales, or sometimes pappus wanting. Leaves opposite.

***** Ray-flowers ligulate and fertile, each subtended by a bract of the mostly one-seried involucre which more or less encloses its akene: disk-flowers hermaphrodite, but some or all of them sterile, their style-branches subulate and hispid: chaff always present between ray and disk flowers: pappus none to the ray-akenes, chaffy or else none to the disk-flowers: commonly glandular-viscid and heavy-scented herbs.

45. **Madia.** Heads many to several-flowered. Involucre ovoid or oblong, few to many-angled by the salient narrow backs of the involucre bracts. Receptacle flat or convex, bearing a single series of bracts enclosing the disk-flowers as a kind of inner involucre, either separate or connate into a cup. Ray-flowers 1 to 20, with cuneate or oblong 3-lobed ligules: their akenes laterally compressed, and enclosed in conduplicate-infolded involucre bracts.

46. **Layia.** Heads many-flowered, broad: ray-flowers 8 to 20, with 3-lobed or toothed ligules. Bracts of the involucre flattened on the back below, with abruptly dilated thin margins infolded so as to enclose the ray-akene. Receptacle broad and flat, bearing a series of thin chaffy bracts between the ray- and disk-flowers. Akenes of the ray obcompressed, almost always smooth, destitute of pappus; those of the disk similar or more linear-cuneate, mostly pubescent, bearing a pappus of 5 to 20 bristles, or scales, or rarely none.

Tribe VI. HELENIOIDEÆ. Disk-flowers hermaphrodite and fertile. Bracts of the involucre not scarious. Differing chiefly from the last tribe in entire absence of chaff.

- * Involucre of narrow equal erect bracts: ligules persistent and becoming papery on the usually striate-nerved akenes: herbage more or less white-woolly; no oil-glands.
- 47. **Riddellia.** Heads with 3 or 4 ray- and 5 to 12 disk-flowers, all fertile. Involucre of 4 to 10 linear-oblong coriaceous woolly bracts, and a few smaller scarious ones within, sometimes an additional narrow outer one. Receptacle small, flat. Ligules as broad as long, abruptly contracted at base into a short tube, truncate and 2 to 3-lobed. Disk-corollas with short externally glandular-bearded teeth. Pappus of 4 to 6 hyaline scales.
- * * Involucre of narrow equal erect bracts, in only one series: ray-flowers female or none, the ligule deciduous: disk-corollas 4-toothed: akenes flat, with only marginal nerves, usually much ciliate: plants not floccose-tomentose, and with no oil-glands.
- 48. **Pericome.** Head many-flowered, homogamous. Involucral bracts lightly connate by their edges into a campanulate cup. Disk-corollas with viscous-glandular tube and much exerted anthers. Akenes strongly villous-ciliate. Pappus a lacerate-ciliate crown, and sometimes a pair of short awns, one from each angle of the akene. Yellow-flowered, with long-acuminate leaves.
- * * * Involucre hardly at all imbricated, its bracts when broad nearly equal or in a single series: ligules not persistent: disk-flowers numerous, mostly with 5 teeth: akenes few-nerved or angled, or more numerous striate-angled when turbinate or pyriform: no oil-glands.
- + Receptacle flat or convex: akenes from linear to obpyramidal, mostly quadrangular, rarely 5-angled: flowers all fertile.
- ++ Involucre mostly hemispherical; the bracts from oblong or oval to broader, not colored or scarious-tipped.
- 49. **Eriophyllum.** Involucre of one or sometimes two series of oblong permanently erect bracts, either distinct or sometimes partially united into a cup, at least in fruit concave at centre, partially receiving the akenes. Receptacle from convex or rarely conical to plane. Ray-flowers usually with broad ligules, very rarely none. Akenes narrow, from clavate-linear to cuneate-oblong, mostly 4-angled. Pappus of nerveless and mostly pointless scales. Floccose-tomentose or rarely glabrate herbs.
- 50. **Bahia.** Involucre hemispherical or obovate and lax or open in fruit; the plane bracts distinct to and commonly narrower at the base, not embracing akenes. Receptacle mostly flat. Female flowers with exerted ligules, or rarely none. Akenes narrow, quadrangular. Pappus of several scarious scales. Not floccose-tomentose.
- ++ ++ Involucre broadly campanulate or turbinate; its bracts from linear-lanceolate and spatulate to obovate or broader, at least the tips membranaceous and colored or petaloid.
- 51. **Hymenopappus.** Involucre broadly campanulate; its bracts 6 to 12, equal, obovate to broadly oblong, thin. Ray-flowers none. Corolla with reflexed or widely spreading lobes. Akenes obpyramidal, 4 to 5-angled, with attenuate base, the faces 1 to 3-nerved, the nerves at maturity sometimes as prominent as the angles. Pappus of 10 to 20 thin-scarious and mostly hyaline obtuse scales.
- 52. **Polypteris.** Involucre from broadly campanulate to turbinate; its bracts from spatulate to linear-lanceolate, commonly in two series and equal. Rays in our species evolute into a palmate ligule and fertile. Corolla of the disk-flowers with long lobes. Stamens wholly exerted. Akenes from linear and downwardly attenuate to clavate-obpyramidal, 4-sided, minutely pubescent. Pappus of 6 to 12 equal hyaline-scarious scales.
- ++ ++ ++ Involucre hemispherical or campanulate; its bracts linear, erect, herbaceous to the tip, inclined to embrace the akenes: heads discoid, or with an inconspicuous ligule.
- 53. **Chaenactis.** Receptacle flat. Akenes slender, linear-tetragonal or more compressed, pubescent. Pappus of hyaline nerveless scales. Leaves mostly cleft or compound.

- + + Receptacle from convex to oblong: involucre of more than one series of bracts: akenes short, obpyramidal or turbinate, 5 to 10-costate or angled, mostly silky-villous or hirsute: disk-flowers all fertile.
- + + Receptacle destitute of awn-like fimbriæ among the flowers.
54. **Actinella.** Involucre campanulate or hemispherical, or sometimes broader; its bracts in two or more series, erect, often rigid; outer sometimes united. Receptacle from conical to convex. Rays fertile. Pappus of 5 to 12 thin and mostly hyaline scales. Mostly low herbs, and bitter-aromatic.
55. **Helenium.** Bracts of the involucre spreading, subulate or linear. Rays fertile or sterile, rarely none. Disk-corollas with 4 to 5-toothed limb; the teeth obtuse, glandular-pubescent. Pappus of usually 5 or 6 thin scarious scales. Leaves commonly impressed-punctate, mostly decurrent.
- + + Receptacle (from convex to globular) beset with setiform or subulate fimbriæ among the flowers.
56. **Gaillardia.** Involucre broad; the bracts in 2 or 3 series, all but the short inner series foliaceous and lax. Ray-flowers neutral; ligules 3-toothed or 3-cleft. Disk-corollas with 5 ovate-triangular to subulate teeth, which are beset with jointed hairs. Akenes turbinate, 5-costate, covered with long villous hairs. Pappus conspicuous, longer than the akene, of 5 to 10 hyaline-scarious scales with a costa mostly excurrent into an awn.
- * * * Involucre of the small heads composed of a few equal connivent bracts in a single series, sometimes one or two small additional ones at base: ligules small, not persistent: akenes terete, oblong or linear, 8 to 10-striate-costate: leaves opposite: no oil-glands.
57. **Flaveria.** Heads one to several-flowered: the flowers all fertile, homogamous and tubular, or one female and short-ligulate. Disk-corollas 5-toothed. Involucre of 2 to 5 mostly carinate-concave bracts. Pappus none.
- * * * * Involucre a series of equal bracts, either distinct or united into a cup or tube, dotted or striped with oil-glands: rays when present fertile: ligules not persistent: akenes mostly narrow and striate: pappus various: mostly glabrous and smooth herbs or undershrubs, strong-scented, the herbage like the involucre commonly dotted with some oil-glands.
58. **Dysodia.** Pappus multisetose-polyadelphous, i. e. all or most of the 10 or more scales resolved, except a basal portion, into several or indefinitely numerous capillary, but rather stiff bristles. Involucre hemispherical or campanulate, usually with a series of loose accessory bracts, the proper bracts generally more or less gamophyllous.
59. **Hymenatherum.** Pappus of several or numerous scales, either 1 to 5 aristate or pointed, or partly resolved into as many bristles, or some or all of them entire and even truncate. Involucre campanulate, gamophyllous high up, with or without some loose accessory bracts. Akenes mostly terete, and striate.
60. **Pectis.** Heads radiate, several to many-flowered. Involucre naked at base, or nearly so, cylindrical or campanulate, of few or several equal carinate bracts in a single series. Disk-corollas 5-lobed, one or two sinuses often deeper, thus becoming bilabiate. Akenes linear, terete or angled. Pappus of few or numerous bristles or awns, sometimes chaffy-dilated at base, or of scales. Opposite-leaved herbs.

Tribe VII. ANTHEMIDEÆ. Akenes usually small and short, with no pappus or a chaffy crown, or a circle of scales. Strong-scented or bitter-aromatic herbs or undershrubs, with alternate leaves. Distinguished from the former tribe chiefly by the scarious involucre.

* Receptacle with chaffy bracts: heads radiate.

61. **Leucampyx.** Involucre broadly hemispherical; its bracts broadly oval, equal, in 2 or 3 series of 4 or 5 each, their margins white-scarious. Ray-flowers 8 or 10, fertile; ligule cuneate-ovate, ample, on a slender glandular tube. Akenes large, obovate-trigonal, with narrowed base and rounded summit, lightly 5-nerved, glabrous, slightly incurved. Pappus an obscure crown, soon obsolete.

62. **Achillea**.¹ Involucre with imbricated bracts as in the last, but campanulate or obovate. Chaffy bracts of the receptacle membranaceous, like the innermost bracts of the involucre. Rays few or several, short and broad. Akenes oblong or obovate, obcompressed, glabrous, destitute of pappus.

* * Receptacle destitute of bracts or chaff.

- + Heads radiate, pedunculate, solitary at the summit of the branches, or sometimes corymbose.

63. **Matricaria**.² Receptacle conical or ovoid, or rarely lower when young. Akenes 3 to 5-ribbed or nerved on the face or sides, rounded on the back.

+ + Heads discoid.

64. **Tanacetum**. Heads corymbosely cymose or glomerate, rarely solitary, many-flowered; female flowers with tubular 3 to 5-toothed corolla. Akenes 5-ribbed or 3 to 5-angular, with broad truncate summit, bearing a coroniform pappus or none. Anther-tips broad and mostly obtuse.

65. **Artemisia**. Heads paniculately disposed, few to many-flowered, small, heterogamous, the female flowers with small and slender tubular corolla, and the hermaphrodite either sterile or fertile; or homogamous, with the flowers all hermaphrodite and fertile. Anther-tips slender and pointed. Akenes obovate or oblong, destitute of pappus.

Tribe VIII. SENECTIONIDEÆ. Involucre mostly one or two series of equal bracts, sometimes unequal or imbricated, with or without accessory ones at base. Leaves usually alternate. Chiefly distinguished by the copious capillary pappus, simple involucre, and naked receptacle.

- * Involucre a series of soft herbaceous bracts: heads subdichæous, racemosely or corymbosely disposed, whitish flowered: herbs with ample mostly radical leaves.

66. **Petasites**. Akenes narrow, 5 to 10-costate, with elongating soft and white pappus.

- * * Involucre lax (not erect-connivent), of much overlapping bracts (4 or 5), many- (at least 20-) flowered: herbs with opposite leaves.

67. **Haploesthes**. Heads radiate; flowers all fertile. Involucre short-campanulate, of similar rather fleshy orbicular or broadly oval bracts, the outer strongly overlapping the inner. Ligules of the rather few and short ray-flowers oval. Akenes linear, terete, striate-costate, glabrous. Pappus a single series of rather rigid and scabrous whitish bristles.

- * * * Involucre of 4 to 6 firm and concave close and strongly overlapping bracts, 4 to 9-flowered: shrubs, with alternate leaves.

68. **Tetradymia**. Heads homogamous. Involucre cylindrical to oblong. Corollas with lanceolate or linear spreading lobes. Anthers wholly exerted. Akenes terete, short, obscurely 5-nerved, from extremely long-villous to glabrate or even glabrous. Pappus of fine and soft minutely scabrous capillary long bristles, white or whitish.

- * * * * Involucre of numerous or several connivent-erect herbaceous equal bracts, many-flowered: herbs, with opposite or alternate leaves.

69. **Arnica**. Heads conspicuously radiate, or the rays rarely wanting. Involucre campanulate, of several thin-herbaceous oblong-lanceolate to linear equal bracts in a single

¹ The Old-World genus *Anthemis* has a naturalized species within our range and may be characterized as follows:—

Anthemis. Involucre hemispherical, many-flowered, of comparatively small imbricated bracts, the outer successively shorter. Chaffy bracts of receptacle sometimes hyaline, sometimes aristiform. Akenes terete or 4 to 10-angled or ribbed, not flattened, glabrous; the truncate summit naked, or with a very short coroniform or auriculate pappus. Heads comparatively large.—See p. 198.

² The following Old-World genus has a naturalized species within our borders:—

Chrysanthemum. Receptacle from flat to hemispherical. Akenes (at least of the disk) 5 to 10-ribbed or nerved all round.—See p. 199.

or somewhat double series. Corollas of the disk-flowers with a commonly elongated hirsute tube. Akenes linear, more or less 5 to 10-costate or angled. Pappus a single series of numerous rather rigid capillary bristles, from scabrous to barbellate. Leaves chiefly opposite.

70. **Senecio.** Heads heterogamous and radiate, or by the absence of ray homogamous and discoid. Corollas yellow. Pappus of soft-capillary and merely scabrous very numerous bristles. Leaves alternate.

Tribe IX. CYNAROIDEÆ. Heads homogamous and tubiflorous, the flowers all hermaphrodite, the corolla lobes long and narrow. Leaves alternate, the teeth or margins often prickly.

71. **Cnicus.**¹ Involucre of numerous much imbricated and often prickly-tipped bracts. Receptacle densely villous-setose. Bristles of the pappus long- and soft-plumose, connate into a ring at base and falling from the akenes in connection. Leaves more or less prickly.

Tribe X. CICHORIACEÆ. Ligule 5-toothed at the truncate apex. Receptacle almost always plane. Herbs, mostly with milky and bitter juice, and alternate leaves. In ours the pappus is always present and the receptacle naked.

* Pappus chaffy or partly so, or bristle-like, or plumose.

72. **Krigia.** Heads several to many-flowered. Bracts of the involucre thin-herbaceous, equal. Akenes short-columnar, many-ribbed, terete or somewhat angular, with broad truncate summit. Pappus double; outer of pointless thin scales; inner of delicate naked bristles. Flowers yellow.

73. **Stephanomeria.** Heads 5 to 12-flowered, rarely 3 to 20-flowered. Involucre cylindraceous or oblong, of several appressed and equal plane membranaceous bracts and some short calyculate ones, not rarely with 2 or 3 of intermediate length, thus becoming imbricate. Akenes 5-angled or ribbed, sometimes with intermediate ribs. Pappus a series of plumose bristles, or rarely chaffy awns. Flowers pink or rose color.

74. **Microseris.** Heads several to many-flowered, on naked simple scapes or peduncles. Corollas mostly with a hairy tube. Akenes 8 to 10-costate, with a basal callosity which is hollowed at the insertion. Pappus simple white; its bristles or awns naked, with chaffy base, or plumose. Flowers yellow.

** Pappus of capillary bristles, scabrous, never plumose nor chaffy.

+ Akenes not flattened: pappus deciduous, mainly all together, soft and white.

75. **Malacothrix.** Involucre many-flowered, either imbricated or only calyculate. Receptacle sometimes with or sometimes without delicate capillary bristles interposed among the flowers. Akenes short, oblong or columnar, glabrous, terete and striately 5 to 15-costate, or 4 to 5-angled by the prominence of stronger ribs, with broad truncate apex having an entire or denticulate border or sharp edge. Pappus a series of soft and scabrous bristles, and commonly 1 to 8 outer and stronger ones which are more persistent and smoother.

+ + Akenes not flattened: pappus persistent, or bristles falling never in connection.

+ + Beak to the akenes none.

= Flowers yellow.

76. **Hieracium.** Involucre several to many-flowered, of narrow equal bracts and some short calyculate ones. Akenes oblong or columnar, smooth and glabrous, mostly 10-ribbed or striate, either terete or 4 to 5-angular, commonly of same thickness to the truncate top, but in several species tapering to a narrower summit. Pappus of rather

¹ The following Old-World genus has a naturalized species within our range: —

Arctium. Involucre globular; bracts slender-subulate or aristiform and spreading above the broader appressed base, hooked at tip. Receptacle densely setose. Pappus of numerous short and rigid or chaffy bristles, separately deciduous. Leaves never prickly. — See p. 212.

rigid scabrous fragile bristles, dirty or tawny, rarely white and soft. Perennials, commonly with hispid or hirsute, or often glandular pubescence.

77. **Crepis**. Involucre few to many-flowered, somewhat imbricated, or more commonly a series of equal bracts and some short calyculate ones. Akenes from columnar to fusiform, 10 to 20-costate. Pappus of copious white and usually soft capillary bristles. Annuals or perennials.

= = Flowers from whitish or cream-color to violet or rose-red.

78. **Prenanthes**. Heads 5 to 30-flowered, mostly nodding. Akenes terete or 4 to 5-angled, commonly striate, with truncate summit. Pappus of copious rather rigid capillary bristles, in one section from whitish to ferruginous. Leafy-stemmed perennials, with paniculate or thyrsoïdly disposed heads; leaves dilated.

79. **Lygodesmia**. Heads 3 to 12-flowered, erect. Akenes terete, obscurely few-striate or angled, commonly linear or slender-fusiform. Pappus of copious and usually unequal capillary bristles, either soft or rigidulous, from sordid-whitish to white. Stems mostly rush-like and striate; leaves narrow-linear or reduced to scales. Flowers rose-colored.

++ Beak to the akenes distinct and slender: heads erect.

80. **Troximon**. Heads many-flowered, solitary, terminating simple naked scapes. Involucre campanulate or oblong, more or less imbricated. Akenes 10-costate or 10-nerved, smooth, not muricate nor sculptured. Pappus white or whitish. Flowers yellow, orange, or rarely purple.

81. **Taraxacum**. Heads many-flowered, solitary, terminating simple and fistulous naked scapes. Involucre campanulate or oblong, a single series of nearly equal narrow bracts, a little cuneate at base, and several or numerous calyculate bracts at the base. Akenes oblong-obovate to fusiform, 4 to 5-costate or angled, muricate or spinulose, the summit abruptly contracted into a filiform beak. Pappus soft and capillary, dull white, no woolly ring at its base. Flowers yellow.

82. **Pyrhopappus**. Heads and involucre nearly of the last, terminating scapose or leafy stems or branches. Akenes oblong or linear-fusiform, about 5-costate or sulcate, muriculate-rugulose, tapering abruptly into a long filiform beak. Pappus copious, soft and capillary, fulvous or rufous, its base usually surrounded by a soft-villous ring. Flowers yellow.

+ + - Akenes flattened: pappus of copious fine and soft capillary bristles: leafy-stemmed plants, with more or less paniculate heads.

83. **Lactuca**.¹ Involucre cylindraceous, or in fruit somewhat conoidal, several to many-flowered. Akenes obcompressed, and with a beak or narrowed summit, which is more or less expanded at apex into a pappiferous disk. Pappus of bright white or rarely sordid bristles, falling separately.

1. VERNONIA, Schreb. IRON-WEED.

Perennial herbs, with alternate pinnately-veined leaves, and usually purple or rose-colored flowers, sometimes varying to white.

1. **V. fasciculata**, Michx. Glabrous, or nearly so, 2 to 5 feet high: leaves thickish, from linear to oblong-lanceolate, conspicuously spinulose-denticulate: heads numerous and crowded on the branches of the compound cyme: involucre (3 or 4 lines high) 20 to 30-flowered; its bracts all obtuse, or some of the uppermost abruptly mucronate-acute. — From the Dakotas to Texas within the eastern limits of our range, and eastward to the Mississippi States.

¹ The following Old-World genus has several species naturalized within our range: —

Sonchus. Involucre campanulate or broader, in age usually broadened and fleshy-thickened at base, and becoming conical. Akenes obcompressed, destitute of beak or neck or dilated pappiferous disk. Pappus of very soft and fine flaccid bristles, which fall more or less in connection, and commonly one or more stronger ones, which fall separately.

2. **V. Jamesii**, Torr. & Gray. Glabrous or nearly so, *a foot or two high: leaves linear-lanceolate or linear*, like those of narrowest forms of the last, but smaller and less or obsoletely denticulate: heads few or numerous in a loose and open corymbiform cyme, all pedunculate: involucre (4 or 5 lines high) 15 to 25-flowered; its bracts all or mostly obtuse. — Fl. ii. 94. Plains of Nebraska and Arkansas to W. Texas and E. New Mexico.

2. EUPATORIUM, Tourn. THOROUGHWORT.

Herbs or shrubby, commonly with opposite leaves, mostly resinous-atomiferous and bitter; the small heads corymbosely cymose or paniculate.

* *Involucre imbricated, the outer bracts successively shorter: herbs.*

+ *Heads 5 to 10-flowered: leaves verticillate.*

1. **E. purpureum**, L. From pubescent to nearly glabrous: stem simple, 3 to 9 feet high: leaves commonly 3 to 6 in a whorl, from oval-ovate to oblong-lanceolate, acuminate, coarsely serrate, reticulate-veiny, the base narrowed into a short petiole: cymes polycephalous, compound-corymbose and numerous: involucre whitish and flesh-colored: flowers dull flesh-color or purple, rarely almost white. — From the Sierra Nevada, eastward across the continent. Known as "Joe-Pye Weed" and "Trumpet Weed." Varies exceedingly; the commonest form being

Var. **maculatum**, Darl. Stem 3 to 4 feet high, often roughish-pubescent, commonly purple, striate or sulcate: leaves somewhat rugose: inflorescence more compact.

+ + *Heads 10 to 20-flowered: leaves opposite.*

2. **E. Bruneri**, Gray. *Minutely puberulent, a foot or two high: leaves acutely serrate, ovate-oblong, 2 or 3 inches long, very short-petioled: paniculate rather slender peduncles bearing 3 or more sessile or short-peduncled heads: involucre campanulate, at least 20-flowered, of comparatively few obscurely striate obtuse bracts; the outer oval, puberulent; inner ones scarious and glabrous, flesh-color: akenes glabrous.* — Synopt. Fl. i. 96. Damp ground, in the Rocky Mountains at Fort Collins, N. Colorado, Dr. Bruner.

3. **E. perfoliatum**, L. Stem 2 to 4 feet high, villous-pubescent, fastigately branched above, stout: leaves lanceolate, connate-perfoliate, tapering gradually to an acuminate apex, finely and closely crenate-serrate, rugose, soft-pubescent, or almost tomentose beneath, 4 to 8 inches long: heads small but very numerous, in dense compound-corymbose cymes, mostly 10-flowered: bracts of the involucre linear-lanceolate, with slightly scarious acutish tips. — From the Dakotas, within the N. E. limit of our range, to Louisiana and eastward across the continent. Known as "Thoroughwort" and "Boneset."

* * *Involucre of bracts all of the same length or nearly so, in one or two series: leaves opposite and petioled: shrubs.*

4. **E. ageratifolium**, DC. Shrub 3 to 7 feet high, with slender and spreading mostly herbaceous branches, green and nearly glabrous: leaves deltoid-ovate, coarsely and rather obtusely dentate, 2 or 3 inches long, slender-petioled: heads pedicelled, numerous in corymbiform cymes, 10 to 30-flowered: involucral bracts 8 to 12, narrowly lanceolate or linear. — *E. Berlandieri*, DC. From S. Colorado to Texas.

3. KUHNIA, L.

Perennials, with mostly alternate leaves, more or less sprinkled with resinous atoms, usually with scattered or cymose-clustered heads of 10 to 30 whitish or at length purple flowers; pappus mostly tawny.

1. **K. eupatorioides**, L. Stem herbaceous, 2 or 3 feet high: leaves from oblong-lanceolate to linear, irregularly few-toothed or upper ones entire, the lower narrowed at base and sometimes short-petioled: pubescence minute or soft and cinereous, or hardly any: heads more or less cymose-clustered. — From Montana to Texas and eastward to Pennsylvania and New Jersey. Very variable.

Var. **corymbulosa**, Torr. & Gray. A foot or two high, stouter, somewhat cinereous-pubescent or tomentulose: leaves rather rigid and sessile, from oblong to lanceolate, coarsely veiny: heads rather crowded. — From the Dakotas and Nebraska to Texas and eastward to the Mississippi States.

4. BRICKELLIA, Ell.

Herbs or undershrubs, with opposite or alternate veiny leaves and heads of white, ochroleucous, or even flesh-colored flowers.

* Heads 30 to 40-flowered, $\frac{1}{2}$ to $\frac{2}{3}$ inch long: leaves slender-petioled, at least the lower ones opposite: perennial herbs.

1. **B. grandiflora**, Nutt. Puberulent or almost glabrous: stem 2 or 3 feet high, paniculately branched: the numerous heads paniculate-cymose and drooping: leaves broadly or narrowly deltoid-cordate, coarsely dentate-serrate and with an entire gradually acuminate apex, the larger 4 inches long: bracts papery and scarious-margined when dried: pappus white, inclined to be deciduous. — In the mountains from New Mexico and Arizona to Montana and Oregon.

Var. **minor**, Gray, is a smaller form, with leaves only an inch or two long, heads proportionally small, involucre fewer-flowered. — Clear Creek, Colorado, to California in the Sierra Nevada, and Arizona.

* * Heads 9 to 25-flowered, not over $\frac{1}{2}$ inch long: leaves distinctly petioled, mostly alternate: stems shrubby at base.

2. **B. Wrightii**, Gray. Usually much branched from a woody base, 2 to 4 feet high, puberulent: leaves broadly deltoid-ovate or rounded-cordate and obtuse, more or less crenate-dentate, $\frac{1}{2}$ to $1\frac{1}{2}$ inches long: heads glomerate-paniculate, the clusters shorter than or little surpassing the subtending leaves: involucre often purple. — Pl. Wright, ii. 72. From Colorado and Arizona to W. Texas.

3. **B. microphylla**, Gray. Glandular-puberulent or pubescent and viscid, a foot or two high from a partly woody base, paniculately much branched; the short leafy branchlets terminated by 1 to 3 heads: leaves subcordate or ovate to oblong, when old somewhat scabrous, sparingly denticulate or nearly entire, the larger $\frac{1}{2}$ inch long, those of flowering branchlets a line or two long: heads nearly $\frac{1}{2}$ inch long, about 15-flowered. — Pl. Wright, i. 85. From S. W. Colorado to California and Oregon.

5. **LIATRIS**, Schreb. BLAZING STAR.

Herbs, with simple virgate very leafy stems from a tuberous or mostly globose and corm-like stock, bearing spicate heads of rose-purple flowers; the leaves all alternate, narrow, entire, rigid, mostly glabrous.

* *Pappus very plumose: heads 16 to 60-flowered.*

1. **L. squarrosa**, Willd. Pubescent or partly glabrous: stem stout, 6 to 20 inches high: leaves all linear and rigid; the lower grass-like: heads few, or sometimes numerous in a leafy spike or raceme, the larger an inch or more long: bracts of the involucre much imbricated, all herbaceous and acuminate, or with foliaceous or herbaceous lanceolate rigid and somewhat pungent tips; these usually squarrose-spreading and prolonged. — Within the eastern limit of our range and extending eastward across the continent.

Var. **intermedia**, DC. Heads narrow: bracts of the involucre erect or little spreading, less prolonged. — Same range as the type, perhaps extending a little farther west.

* * *Pappus plainly plumose to the naked eye: heads 4 to 6-flowered.*

2. **L. punctata**, Hook. Stems a span to 30 inches high from a thick and branching or sometimes globular stock, stout: leaves all narrowly linear, as well as bracts commonly punctate, rigid: head oblong or cylindraceous, thickish, from $\frac{1}{2}$ to $\frac{3}{4}$ inch long, mostly numerous and crowded in a dense spike: bracts of the involucre oblong, abruptly or sometimes more gradually cuspidate-acuminate, often lanuginous-ciliate. — On the plains from the Saskatchewan to Montana and southward to Texas and New Mexico.

* * * *Pappus minutely barbellate, not plumose: heads 25 to 40-flowered.*

3. **L. scariosa**, Willd. Pubescent or glabrate: stem stout, 1 to 5 feet high: leaves spatulate- or oblong-lanceolate and tapering into a petiole, 4 to 6 inches long; upper narrowly lanceolate; uppermost small, linear, sessile: heads racemose or spicate, few or numerous (3 to 50), about an inch high and wide or much smaller: involucre bracts broadest and rounded at summit, there either herbaceous or scarious edged and tinged with purple (rarely white-scarious). — From the Rocky Mountains eastward across the continent. Extremely variable.

6. **GUTIERREZIA**, Lag.

Ours is a suffruticose plant, with narrow entire and alternate leaves, small heads of yellow flowers, and pappus of ray and disk similar, consisting of chaffy scales which vary from narrowly oblong to linear-subulate.

1. **G. Euthamiæ**, Torr. & Gray. Bushy, from glabrous to puberulent, 6 to 18 inches high, with mostly strict and fastigiate polycepalous branches: leaves narrowly linear, verging to filiform: heads mostly clavate-oblong, few to several-flowered, not over 2 lines long, some short-pedunculate, others 3 to 5 in a glomerule: flowers of disk and ray not numerous: akenes sericeous-pubescent. — From the Saskatchewan and Montana to New Mexico and California.

7. **GRINDELIA**, Willd. GUM-PLANT.

Herbs of coarse habit; with sessile or partly clasping and usually serrate rigid leaves, and rather large heads of yellow flowers terminating the branches; the narrow rays numerous, occasionally wanting. Heads more or less viscid, especially before blooming, but the herbage glabrous (in ours).

* *Akenes squarely truncate and even at the summit, not toothed: pappus-awns*
2 or 3.

1. **G. squarrosa**, Dunal. Commonly only a foot or two high and branched from the base: leaves rigid; cauline from spatulate- to linear-oblong and with half-clasping base, acutely and often spinulose serrate or denticulate; sometimes radical and even cauline laciniate-pinnatifid: involucre strongly squarrose with the spreading and recurving short-filiform tips of the bracts: outer akenes commonly corky-thickened and with broad truncate summit, those toward the centre narrower and thinner-walled. — On the plains, from the Saskatchewan to Texas and westward to the Sierra Nevada.

Var. **nuda**, Gray. Rays wanting. — With the radiate form in Colorado and New Mexico.

* * *Akenes narrow, excisely truncate or bidentate at summit: pappus awns*
mostly 2.

2. **G. nana**, Nutt. Rather low and slender, 6 to 30 inches high, the larger plants corymbosely and freely branched above: leaves thinnish, lanceolate and linear, or the lower spatulate, entire or spinulose serrate: heads small: bracts of the involucre with slender and squarrose soon revolute tips, as in the last: rays 16 to 30. — From N. W. Wyoming to Oregon and Washington; replacing *G. squarrosa* in the Northwest.

8. **CHRYSOPSIS**, Nutt. GOLDEN ASTER.

Herbs, with pubescence from hispid to silky, leaves entire or few-toothed, yellow flowers in middle-sized heads terminating the stem and branches. Our single species includes a multitude of forms, the more marked of which are given as varieties.

1. **C. villosa**, Nutt. A foot or two high: leaves from oblong to lanceolate, rarely few-toothed, usually cinereous or canescently strigose or hirsute and sparsely hispid along the margins and midrib, an inch or two long: heads mostly terminating leafy branches, sometimes rather clustered, naked at base or leafy-bracteate: involucre campanulate, 4 or 5 lines high; its bracts commonly strigulose-canescant, sometimes almost smooth, acute: akenes oblong-obovate, villous: outer pappus of chaffy bristles — On open ground from the Saskatchewan to Alabama and westward across the continent.

Var. **hispidula**, Gray. Small and low, with hirsute and hispid pubescence, not canescent: heads particularly small: involucre not canescent, sometimes glabrous. — Proc. Acad. Philad. 1863, 65. Saskatchewan to W. Texas and Arizona.

Var. **discoidea**, Gray. Heads destitute of rays: involucre somewhat canescent: otherwise nearly as the last. — Synopt. Fl. i. 123. Cañons, W. Montana, Watson.

Var. **foliosa**, Eaton. Canescent with appressed sericeous pubescence, mostly soft and destitute of hispid bristles; but stem often hirsute or villous: leaves short, oblong or elliptical: heads small, rather numerous and clustered. — Bot. King Exp. 164. Mountains of Wyoming to Utah and Arizona.

Var **Rutteri**, Rothrock. Most like the preceding, equally sericeous-canescenscent with usually longer soft hairs: heads of double the size, fully $\frac{1}{2}$ inch high and wide, solitary or few in a cluster, foliose-bracteate: rays 30 to 40, $\frac{1}{2}$ inch long. — Wheeler Rep. vi. 142. S. Arizona; also Colorado, where the leaves are slightly canescent.

9. APLOPAPPUS, Cass.

A large and polymorphous genus; mostly herbaceous, some suffruticose: the flowers all yellow, and occasionally rayless, thus making them undistinguishable from the following genus.

* *Involucre of firm well-imbricated or rigid bracts: rays numerous, several, or wanting: pappus commonly fuscous or rufous, and more or less rigid.*

+ *Heads rayless: akenes sericeous-canescenscent: leaves coriaceous, dentate.*

1. **A. Nuttallii**, Torr. & Gray. Herbaceous from a woody stock, a span to a foot high: leaves from spatulate-oblong to almost lanceolate: heads few terminating the branches, one third inch high: involucre hemispherical; the bracts with slightly spreading greenish tips. — From New Mexico and Arizona to Idaho and the Saskatchewan.

+ + *Heads conspicuously radiate, large and showy: rays very numerous, $\frac{1}{2}$ to 1 inch long: akenes wholly glabrous: leaves coriaceous, entire.*

++ *Stems equally and very leafy up to the sessile or subsessile heads.*

2. **A. Fremonti**, Gray. A foot or less high, simple or fastigiately branched above: leaves lanceolate, 2 to 4 inches long, obscurely 3 to 5-nerved; lower narrowed and upper partly clasping at base: involucre (inch or less high) broadly campanulate; its bracts broadly lanceolate, conspicuously and often cuspidately acuminate: rays $\frac{1}{2}$ inch long. akenes obovate, striate-nerved, almost as long as the rigid pappus. — Proc. Acad. Philad. 1863, 65. Colorado.

Var. **Wardi**, Gray. Dwarf: fascicled stems only a span high: leaves proportionally small, linear lanceolate, destitute of lateral nerves: heads one-half smaller, 2 or 3 in a terminal glomerule: akenes double the length of the scanty pappus. — Synopt. Fl. i. 128. Wyoming, L. F. Ward.

++ ++ *Stems simple, above with decreasing or sparse leaves and solitary or few naked and usually pedunculate heads, at base a tuft of ample lanceolate- or spatulate-oblong radical leaves.*

3. **A. croceus**, Gray. Stem stout and erect, commonly a foot or two high, and with radical leaves a foot or less long (including the petiole): cauline leaves ovate-oblong to lanceolate, partly clasping: head mostly solitary: involucre a full inch in diameter; its bracts ovate to spatulate-oblong, very obtuse, lax, inner with scarious erose-denticulate margins: rays saffron-yellow, sometimes inch long: akenes narrowly oblong, nearly the length of the pappus. — Proc. Acad. Philad. 1863, 65. Mountains of Colorado.

4. **A. integrifolius**, T. C. Porter. Stems several from the caudex, ascending, a foot or less high: radical leaves 3 to 8 inches (including short

petiole or tapering base); cauline lanceolate, or small uppermost linear: heads solitary or 2 or 3 in axils, smaller than in foregoing: involucre bracts narrowly oblong to linear-lanceolate, some loose outer ones usually equalling the disk and more foliaceous: rays bright yellow, half-inch long: immature akenes oblong. — Gray, Proc. Am. Acad. xvi. 79. Mountain meadows, Wyoming, and Montana.

+ + + Heads conspicuously radiate, smaller: rays $\frac{1}{2}$ to barely $\frac{1}{4}$ inch long: akenes silky pubescent or villous.

+ + Mostly simple stems with a tuft of radical leaves: leaves coriaceous, entire or spinulose-serrate, the cauline diminished upwards: rays 20 to 50: pappus pale, rather soft and fine.

5. **A. uniflorus**, Torr. & Gray. Stems a span to barely a foot high, ascending or erect, sometimes 5 to 6-leaved; sometimes rather scapiform or upper leaves reduced and bract-like, bearing a solitary head, rarely one or two from lower axils: leaves lanceolate or sometimes broader; radical 2 or 3 inches long and usually petioled: involucre commonly $\frac{1}{2}$ inch high and the linear or oblong-linear bracts all of same length, rather loose, outer all foliaceous. — *A. uniflorus* & *A. inuloides*, Torr. & Gray, Fl. ii. 241. From the Saskatchewan to Montana, Utah, and Colorado.

6. **A. lanceolatus**, Torr. & Gray. Habit of the preceding: stems generally more leafy and bearing 3 to 15 heads; these when few subcorymbose, when more numerous racemously or paniculately disposed: involucre in the type fully $\frac{1}{2}$ inch high; its bracts rather closely imbricated in 3 or 4 unequal series, lanceolate, acutish, with short green tips and whitish coriaceous base; outer successively shorter, occasionally some of them longer and more herbaceous. — Eaton, Bot. King Exp. 160. From the Saskatchewan to British Columbia and N. Nevada.

Var. **Vaseyi**, Parry. Heads a third or quite half smaller, disposed to be racemose and involucre closer. — Saskatchewan to Wyoming, Utah, and Colorado.

+ + + Very dwarf from a multicapital caudex, leafy up to the small heads: leaves all narrow and entire: rays 7 to 10: pappus scanty, somewhat fulvous.

7. **A. multicaulis**, Gray. Very dwarf, tufted, tomentulose, but early glabrate and smooth: stems 1 to 3 inches high from a ligneous caudex, simple or forked, bearing 3 or 4 leaves and few heads: leaves narrowly linear, or the lowest obscurely spatulate, an inch long: bracts of the involucre large and rather few (9 to 14), from ovate to oblong-lanceolate, cuspidate-acuminate, marked with a green spot below the slender cusp, or the outermost with a larger foliaceous tip. — Am. Nat. viii. 213. On rocks, mountains of N. W. Wyoming.

+ + + Branching and leafy: leaves not rigid, dentate or pinnatifid, the teeth and tips bristle-tipped: rays conspicuous, 15 to 30: pappus rather rigid, its bristles very unequal in size and strength.

8. **A. rubiginosus**, Torr. & Gray. One to three feet high, viscid-glandular and pubescent: leaves lanceolate or narrowly oblong, incisely pinnatifid or dentate with salient narrow teeth: heads somewhat cymosely paniculate, 5 or 6 lines high, usually naked pedunculate: bracts of the involucre linear-subulate,

with slender spreading green tips: rays deep golden-yellow. — Fl. ii. 240. From S. Texas to the plains of Colorado as far as the mountains.

9. **A. spinulosus**, DC. *Canescently puberulent or glabrate: stems a span to a foot high, cymosely branching at summit: leaves pinnately and the lower often bipinnately parted into rather numerous lobes; lobes and teeth, as well as appressed involucre bracts setaceous-tipped.* — Plains, from the Saskatchewan to Texas and westward to the Dakotas, Colorado, and Arizona.

* * *Bracts of the involucre from ovate to lanceolate or even linear, not rigid, all of equal or about equal length: rays several or numerous: pappus soft and white or whitish: leaves all entire.*

+ *Heads cymose or glomerate at the summit of a leafy stem: involucre campanulate: rays 12 to 20, small and narrow: akenes short and glabrous or nearly so.*

10. **A. Parryi**, Gray. Green and almost glabrous, puberulent, and somewhat viscid above: stems 6 to 18 inches high: leaves oblong-obovate and spatulate, or the upper oblong-lanceolate, thinnish, 2 to 4 inches long: heads nearly $\frac{1}{2}$ inch high, rather numerous: involucre bracts oblong, obtuse, pale, and in about three moderately unequal ranks: flowers pale yellow. — Am. Jour. Sci. ii. xxxiii. 10. Mountains of Colorado to the Wasatch.

+ + *Dwarf: heads solitary, terminating simple stems or branches: rays conspicuous.*

+ + *Wholly herbaceous, chiefly alpine, disposed to be caespitose, a span or less in height: leaves soft, not persistent: involucre hemispherical: rays 15 to 20.*

= *Green, not woolly, mostly equally leafy up to the head.*

11. **A. pygmæus**, Gray. Less than a span high, soft-pubescent or glabrate, not viscid nor glandular: leaves from linear-spatulate to spatulate-oblong: involucre bracts oblong, outer ones foliaceous and loose, very obtuse, equalling the thinner innermost: akenes pubescent. — Am. Jour. Sci. ii. xxxiii. 239. Alpine region of Colorado mountains.

12. **A. Lyalli**, Gray. Rather taller, larger-leaved, viscid-puberulent: leaves obovate-spatulate to oblanceolate: involucre glandular; its bracts lanceolate, acute, sometimes 2 or 3 outermost oblong and more foliaceous: akenes and ovaries glabrous or nearly so. — Proc. Acad. Philad. 1863, 64. Alpine region of Colorado mountains; also in Montana, Oregon, and northward.

= = *Woolly or tomentose, at least the involucre, above less leafy, or head pedunculate.*

13. **A. lanuginosus**, Gray. Fully a span high from creeping root-stocks, floccose-tomentose: leaves soft, narrowly spatulate or upper linear, an inch or two long; the sparse uppermost almost filiform: bracts lanceolate, acute or acuminate, thin, nearly equal, in two series, outer barely greenish: akenes sericeous-canescens. — Wilkes Ex. Exped. xvii. 347. From Montana, Watson, to the mountains of Washington.

+ + *Depressed-caespitose from a multicapital woody caudex, glabrous or puberulent: leaves rigid and persistent, crowded on the crowns of the caudex or on short shoots, a few on the scapiform flowering stems: rays 6 to 15: akenes canescently villous.*

14. **A. acaulis**, Gray. Leaves from spatulate to oblanceolate or linear, mucronate, more or less 3-nerved and the broader ones veiny, commonly sca-

brous: scapiform flowering stems an inch to a span high, mostly monocephalous: *bracts of the involucre from ovate to ovate-lanceolate, mucronately acute or acuminate, destitute of greenish tips*; the outer a little shorter than the inner. — Proc. Am. Acad. vii. 353. In the mountains from the Saskatchewan to California and Oregon.

Var. **glabratus**, Eaton. Glabrous and smooth or nearly so: flowering stems disposed to be leafy above and to branch, so bearing 2 or 3 heads. — Bot. King Exp. 161. Wyoming to Nevada and Arizona.

15. **A. armerioides**, Gray. Smooth and glabrous: flowering stems naked above for 1 to 3 inches, sometimes nearly scapiform: *bracts of the campanulate involucre broadly oval, rounded-obtuse or retuse, muticous, of about three lengths*; the outermost much shorter, *most of them greenish at apex*. — Rocks on mountains, from Wyoming to New Mexico and S. Utah.

* * * *Heads mostly solitary, terminating leafy branches: involucre of lanceolate or linear bracts in few ranks and of somewhat equal length; outer with conspicuous leafy tips, or loose and foliaceous, passing into leaves: rays few and conspicuous, or wanting: pappus soft and slender: low and many-stemmed from a suffrutescent base: leaves soft, spatulate-oblong to broadly linear, sessile, entire.*

16. **A. suffruticosus**, Gray. *Destitute of tomentum: stems glandular-pubescent or puberulent: heads $\frac{3}{8}$ to $\frac{1}{2}$ inch high: rays 2 to 5 and somewhat exserted, or none: disk-flowers 10 to 30.* — Proc. Am. Acad. vi. 542. Alpine or subalpine, from California to Oregon and N. Wyoming.

17. **A. Macronema**, Gray. Stems stouter, *whitened by a dense and close tomentum: head commonly larger, one inch long: rays always wanting.* — Loc. cit. Mountains of Colorado, Wyoming, and westward.

10. BIGELOVIA, DC. RAYLESS GOLDEN-ROD.

Mostly suffrutescent or more shrubby plants, generally few-flowered, but grading easily into both *Solidago* and *Aplopappus*. Includes *Linosyris*.

* *Heads comparatively large, at least $\frac{1}{2}$ inch long, but narrow, 5 to 20-flowered: bracts of the involucre chartaceous and acuminate, some of the outer prolonged into a slender herbaceous tip; when numerous the vertical ranks are more or less apparent: low and suffrutescent, with linear entire leaves, not punctate nor viscid.*

— *Style-appendages conspicuously exserted: akenes pubescent: stems and branches whitened (at least when young) by a close tomentum.*

1. **B. Parryi**, Gray. Stems rather strict, leafy to the summit: leaves linear, 2 or 3 inches long, 2 lines or less wide, *obscurely 3-nerved*, glabrous; upper ones hardly diminished in size and overtopping all the heads of the strict and narrow thyrsiform-virgate panicle: heads 10 to 15-flowered: bracts of the involucre about 12. — Parks of the Colorado mountains.

2. **B. Howardi**, Gray. Low, rather tufted, canescently tomentulose when young: leaves narrowly linear, rigid, *an inch or two long, barely a line wide, obscurely 1-nerved*; upper mostly overtopping the *glomerate narrow heads: involucre 5-flowered*; its bracts 15 to 18. — Proc. Am. Acad. viii. 641. Parks of the Colorado mountains to New Mexico and Utah.

+ + *Style-appendages hardly exerted: akenes glabrous: involucre 15 to 20-flowered: herbage glabrous throughout.*

3. **B. Engelmanni**, Gray. A span or two high, in tufts from a subterranean branching caudex: stems simple, very leafy up to the cymose-glomerate heads: leaves all narrowly linear, an inch or two long, only a line wide, rigid: bracts of the involucre regularly imbricated and appressed, outer similar but short, all abruptly mucronate or short-cuspidate, slightly greenish below the tip.—Proc. Am. Acad. xi. 75. Plains of Colorado at Hugo Station.

* * *Heads narrow or small, 5-flowered, mostly numerous and crowded: involucre of dry chartaceous more or less keeled bracts imbricated so as to form 5 conspicuous vertical ranks: shrubby and branching, with narrow entire leaves.*

+ *Akenes and ovaries glabrous, 4 to 6-angled: pappus rigidulous: bracts of the involucre acute or acuminate, numerous and strictly 5-ranked, 5 or 6 in each vertical rank: herbage not punctate, slightly or not at all resinous.*

4. **B. depressa**, Gray. Obscurely puberulent and pale, a span or two high from a decumbent woody base: branches leafy up to the glomerule or fasciculate cyme of few heads: leaves short, about $\frac{1}{2}$ inch or less long, lanceolate or lowest rather spatulate, rigid, mucronate-acute, with carinate midrib and no veins: heads $\frac{1}{2}$ inch long: involucre bracts lanceolate, gradually acuminate into an almost setaceous tip.—Plains of S. Colorado to New Mexico and S. Utah.

5. **B. pulchella**, Gray. Glabrous and green, shrubby, 2 or 3 feet high, fastigiately much branched, very leafy up to fastigate-cymose heads: leaves narrowly linear, plane, an inch or less long, rather obtuse, with ciliolate-scabrous margins and midrib not prominent: heads $\frac{3}{8}$ to $\frac{1}{2}$ inch long: involucre bracts rigid-chartaceous, much carinate, acute and cuspidate-mucronate.—W. Texas to New Mexico and Colorado.

6. **B. Bigelovii**, Gray. Canescent with fine close tomentum when young, glabrate, shrubby, a foot to a yard high, fastigiately much branched, rigid: branches less leafy, bearing a few fastigate-clustered heads, $\frac{1}{2}$ to $\frac{3}{8}$ inch high: leaves nearly filiform: involucre bracts lanceolate, acute, thinnish, all pale.—N. New Mexico and adjacent Colorado.

+ + *Akenes canescently pubescent or villous: herbage commonly graveolent and mostly becoming more or less resinous or viscid.*

+ + *Leaves numerous, filiform: involucre bracts 3 in each vertical rank, mostly with small subulate spreading or recurving tips.*

7. **B. Greenei**, Gray. Suffruticose, about a foot high, green and glabrous, more or less balsamic-viscid: leaves very numerous on the branches, filiform-acerose, but flat, and margins minutely scabrous: heads numerous and fastigate-cymose, 3 or 4 lines high.—Proc. Am. Acad. xi. 75. Colorado, on the Huerfano Plains and near Twin Lakes; also in Utah.

+ + *Leaves numerous, from filiform-linear to broadly linear or lanceolate: bracts of the involucre obtuse or somewhat acute.*

8. **B. graveolens**, Gray. A foot to a yard or more high, bearing numerous crowded heads: these $\frac{1}{2}$ or $\frac{3}{8}$ inch high: leaves mostly flocculent-tomentose when young, often glabrate in age, not rigid; the larger spatulate-linear, or

linear-lanceolate, 2 inches long and 2 lines wide, *obscurely if at all 3-nerved*; the narrowest almost filiform, at least when dry, and *margins involute*: involucre *thin-chartaceous* when dry: corolla-lobes or teeth short, from lanceolate to nearly ovate: akenes linear: *pappus soft*. — Proc. Am. Acad. viii. 644. From New Mexico and S. California to the Dakotas and British Columbia. An exceedingly polymorphous species, the following varieties representing the principal forms within our range.

Var. **glabrata**, Gray. Includes forms with the usually narrow leaves early glabrate or perhaps glabrous from the first, sometimes balsamic, sometimes not. — Not rare in Colorado, where even the branches sometimes early lose their light tomentum.

Var. **albicaulis**, Gray. Branches for the most part permanently and very densely white-tomentose and leaves floccose-tomentose: involucre either tomentulose or glabrate; its bracts commonly acutish: corolla-lobes more or less lanceolate and the tube villous-pubescent. — Mountains of Wyoming to British Columbia; also in California.

Var. **latisquamea**, Gray. Rather stout, white-tomentose or partly glabrate: heads numerous in the corymbiform cymes: bracts of the glabrous involucre mostly elliptical-oblong, very obtuse: lobes or teeth of the corolla short, somewhat lanceolate, the tube glabrous. — S. E. Colorado to New Mexico and S. Utah.

9. **B. Douglasii**, Gray. *Green, no tomentum*: from 6 inches to 6 feet high, *fastigiate*ly branched, sometimes *resinous-viscid*, often slightly or not at all so. leaves from very narrowly linear or almost filiform (*but plane*) to lanceolate-oblong, *mostly 3-nerved*: heads few or numerous and fastigate-cymose: bracts of the involucre comparatively few, only 2 to 4 in each vertical rank, from broadly to linear-oblong or lanceolate, obtuse, *firm-chartaceous*: *pappus rigidulous*. — From the Dakotas to Washington and southward into California and New Mexico. Very variable, with the following principal forms.

Var. **pumila**, Gray. A dwarf northern and mountain state, a span or two high glabrous or minutely puberulent and disposed to be viscidulous; the simple branches bearing very few heads in a close cluster: outer involucre bracts either somewhat greenish-tipped or passing into bract-like leaves. — N. Montana to Washington and mountains of Utah.

Var. **serrulata**, Gray. Taller: leaves linear or narrowly lanceolate, serrulate-ciliolate, sometimes scabrous and rigid. — Common through the whole dry interior region.

Var. **tortifolia**, Gray. Leaves twisted: otherwise like the preceding. — Plains of Colorado to California.

Var. **lanceolata**, Gray. Low, but bearing compact cymes of numerous (5 to 7-flowered) heads: leaves short, lanceolate or broadly linear, puberulent. — Synopt. Fl. i. 140.

+ + + *Akenes and ovaries glabrous, nearly terete: bracts of the involucre rounded-obtuse: suffrutescent, green and glabrous.*

10. **B. Vaseyi**, Gray. A span or two high, somewhat balsamic-viscid, leafy up to the fastigate-cymose cluster of heads: leaves linear or spatulate-linear, obtuse, plane: involucre 3 or 4 lines long; its bracts narrowly oblong,

firm chartaceous, and all but innermost with a thickened greenish spot at the very obtuse apex : pappus fine and soft, rather short. — Proc. Am. Acad. xii. 58. Colorado mountains, in Middle Park and Gunnison Valley ; also in Utah.

* * * *Heads several to many-flowered : bracts of the involucre coriaceous, and usually somewhat herbaceous or thickened at the obtuse apex, all strictly appressed and imbricated, but the vertical ranks inconspicuous : akenes pubescent : leaves linear, entire or sparingly dentate : herbaceous down to the suffrutescent base.*

11. **B. pluriflora**, Gray. Leaves narrowly linear, entire : heads 15 to 18-flowered, 4 lines high : involucre somewhat turbinate, very smooth ; *its thinnish bracts lanceolate, acute* : otherwise like the next, of which it is probably a form. — Colorado ? probably on the Arkansas or South Fork of the Platte, James in Long's expedition.

12. **B. Wrightii**, Gray. Commonly glabrous or nearly so : stems rather strict and slender, a foot or two high : leaves thickish, narrowly linear, entire, sometimes *lower ones sparingly laciniate-dentate*, margins either smooth or sparingly scabrous : heads (4 or 5 lines high) 7 to 15-flowered, usually numerous and crowded in a corymbiform cyme : bracts of the involucre *oval-oblong to broadly lanceolate, obtuse* ; the back at or near the apex usually greenish. — W. Texas to S. Colorado and Arizona.

Var. **hirtella**, Gray. Leaves cinereous-hirtellous or hirsute-pubescent and roughish, but often glabrate in age or only ciliolate : stems sometimes pubescent. — Synopt. Fl. i. 142. Same range.

11. SOLIDAGO, L. GOLDEN-ROD.

Herbs, with mostly strict stems, entire or serrate alternate leaves, the cauline sessile or nearly so, the radical tapering into margined petioles : the small heads thyrsoïd-glomerate, or sometimes cymose, or more commonly in raceme-like secund clusters : flowers yellow.

§ 1. *Receptacle honeycombed : rays generally fewer or not more numerous than disk-flowers.* — VIRGAUREA.

* *Heads mostly large, 4 to 6 lines long, many-flowered, collected in thyrsoïdal inflorescence which is not at all secund nor raceme-like : rays 6 to 14 : akenes pubescent : leaves veiny from a simple midrib, mostly bright green : stems low. Ours are mountain or high-latitude forms.*

1. **S. multiradiata**, Ait. Villous-pubescent above or glabrate : leaves minutely and sparingly serrate above, sometimes entire ; cauline spatulate to lanceolate, all tapering gradually to the base, or the radical into a slender margined petiole : heads generally few and glomerate in a single terminal roundish or oblong compact cluster, occasionally with one or two looser axillary clusters or branches : bracts of the involucre narrowly lanceolate, acute : rays numerous and narrow. — *S. Virgaurea*, var. *multiradiata*, Torr. & Gray. Across the continent in high latitudes and extending southward along the Rocky Mountains to Colorado and New Mexico, where the usual form is

Var. **scopulorum**, Gray. More glabrous, 3 to 18 inches high, commonly strict : heads when numerous in a more open or compound cluster, mostly

smaller bracts of the involucre closer, shorter, and merely acute.—Proc. Am. Acad. xvii. 187.

2. **S. humilis**, Pursh. *Glabrous, disposed to be glutinous, bright green stems strict, leafy: upper leaves lanceolate to nearly linear, entire; lower and radical becoming spatulate with long attenuate base, sparingly appressed-serate above the middle: heads rather crowded in a narrow racemiform paniculate simple or sparingly branched thyrsus: bracts of the involucre oblong-linear, obtuse.*—*S. Virgaurea*, var. *humilis*, Gray, Man. In the mountains of New Mexico and Colorado, and extending northward to the British possessions, where it ranges eastward across the continent.

Var. **nana**, Gray. A high alpine form, 2 to 5 inches high, with spatulate to obovate leaves, and few heads in a close glomerule, or more numerous in a spike-like thyrsus.—Synopt. Fl. i. 148. *S. Virgaurea*, var. *humilis*, Gray, Proc. Am. Acad. viii. 389. *S. Virgaurea*, var. *alpina*, of Fl. Colorado and Wheeler's Report. High mountains of Colorado and in the Cascades.

* * *Heads smaller, 2 or 3 (rarely 4) lines long, not in a terminal cyme, but in paniculate or raceme-like clusters, which when well developed are collected in a terminal compound panicle or panicles; when the clusters are raceme-like and spreading they are apt to be secund: stems branching only at summit.*

+ *Neither alpine, canescently pubescent, nor the leaves triple-ribbed: leaves entire or little serrate.*

3. **S. spectabilis**, Gray. A foot or two high: *heads numerous and crowded in a narrow or compound and broader thyrsus: cauline leaves lanceolate, or the small uppermost becoming linear, acute; lower and radical spatulate-lanceolate or oblong, acutish or obtuse, often an inch wide and obscurely triple-ribbed; radical rarely with a few serratures: involucre bracts lanceolate or broader, mostly obtuse: rays 8 to 15, small: akenes pubescent.*—Proc. Am. Acad. xvii. 193. *S. Guiradonis*, var. *spectabilis*, Eaton. From the Eastern slopes of the "Front Range" in Colorado to western slopes of the Sierra Nevada.

4. **S. speciosa**, Nutt. Commonly 3 to 6 feet high and robust: *leaves thicker and generally ample, oval or oblong, rather abruptly narrowed into a sessile base, or the larger into a winged petiole, often 4 to 6 inches long and 2 or 3 wide; uppermost small and lanceolate or oblong; primary veins spreading and obscure: thyrsus narrow, composed of numerous short or rarely elongated spiciform clusters, rigid, rather showy: heads 3 or 4 lines long: bracts of the well-imbricated involucre of firm texture, narrowly oblong, very obtuse, and with a greenish midnerve: rays conspicuous, 5 or 6: akenes glabrous or nearly so.*—Hardly extending into our range, but represented at its eastern border by the

Var. **rigidiuscula**, Torr. & Gray, which is not so tall, has smaller leaves, the lower being spatulate or oblanceolate and only 2 to 4 inches long and hardly an inch wide, the upper more rigid and rougher-edged, and the thyrsus more simple.

+ + *Leaves more or less triple-ribbed, or with a pair of lateral veins continued parallel to the midrib.*

+ + *Smooth and glabrous, at least as to the stem and bright green leaves: inflores-*

cence when developed of naked and secund commonly recurving raceme-like clusters collected in a terminal panicle.

5. **S. Missouriensis**, Nutt. *Low or middle-sized: leaves thickish, with scabrous margins, mostly tapering to both ends, and the serratures when present sharp and rigid; lower spatulate-lanceolate, larger 4 to 6 inches long; upper mostly linear and entire, acute; sometimes all entire: racemiform clusters approximated in a short and broad panicle, recurving in age: rays 6 to 13, small: bracts of the involucre mostly ovate.*—From the eastern slopes of the mountains to the Mississippi Valley States.

Var. **montana**, Gray. *Dwarf, 6 to 15 inches high: leaves entire or with few small serratures; cauline obscurely triplinerved, an inch or two long: panicle small and compact, at most 2 or 3 inches long; its clusters short, crowded, seldom recurved or much secund.*—Proc. Am. Acad. xvii. 195. From Idaho to the Dakotas and the Saskatchewan.

Var. **extraria**, Gray. *A foot or two high, robust: leaves broader, the largest sometimes an inch wide, sparingly serrate or entire: heads rather larger: rays more conspicuous.*—Loc. cit. Dry ground, in the mountains, Colorado to S. Arizona.

6. **S. serotina**, Ait. *Stem stouter and taller, 2 to 7 feet high, very smooth up to or near the ample panicle, which is sometimes more or less hairy: leaves thinner, lanceolate or broader, sharply and saliently serrate: rays 7 to 14, moderately large and conspicuous: bracts of the involucre broadly linear.*—From Oregon to Texas and eastward.

++ ++ *Minutely pubescent or glabrate, not cinereous or scabrous: leaves thinnish, the lateral ribs generally obscure: panicle mostly erect and thyrsiform; heads little if at all secund: rays 12 to 18, small.*

7. **S. elongata**, Nutt. *One to three feet high: leaves lanceolate to oblong, 3 or 4 inches long, very sharply and mostly coarsely serrate: thyrsus rather compact, 3 to 8 inches long, its branches occasionally spreading: bracts of the involucre linear, acutish or obtuse.*—From California to British Columbia and eastward to Montana.

++ ++ ++ *Pubescent (at least the stem), either hirsutely or canescently: branches of the panicle when well developed secund.*

= *Leaves tapering gradually to an acute or acuminate point, generally thin or thinnish: panicle open, of naked and secund mostly recurving racemiform clusters: bracts of the involucre narrow and thin: rays small and short.*

8. **S. Canadensis**, L. *Stem 2 to 6 feet high, from scabrous-puberulent to hirsute: leaves mostly lanceolate, puberulent, pubescent, or nearly glabrous, sharply serrate or the upper entire, veiny, and with lateral ribs prolonged parallel to the midrib: heads small, ordinarily only 2 lines long: bracts of the involucre small and pale, narrowly linear, acutish or obtuse: rays 9 to 16, more numerous than the disk-flowers.*—From Arizona to British Columbia and eastward across the continent.

Var. **procera**, Torr. & Gray. *Leaves less serrate or the upper entire, at least the lower face and upper portion of the stem cinereous-pubescent with very short and fine pubescence: inflorescence less open or the branches ascending in less developed or cultivated plants: heads sometimes larger.*—From Idaho to Texas and the Saskatchewan.

= = *Leaves obtuse or abruptly apiculate, firm or coriaceous: pubescence all close: panicle mostly naked and compact: bracts of the involucre broadish and obtuse, of firm texture: rays fewer and larger, golden yellow.*

9. **S. nemoralis**, Ait. Mostly low, with fine close soft or (in age) scabrous pubescence: leaves from spatulate-obovate to oblanceolate or linear; radical and lower cauline sparingly serrate: thyrsus and its compact racemiform clusters secund, commonly recurved-spreading: bracts of the involucre oblong-linear or narrower, obtuse: rays 5 to 9. — From Arizona to Nevada and eastward across the continent.

Var. **incana**, Gray. Dwarf, span to a foot high: leaves oval or oblong, rigid, canescent, sometimes strongly serrate and sometimes mostly entire: racemiform clusters erect or the lower spreading, collected in a dense oblong or conical thyrsus. — From the mountains of Colorado and Montana to the Dakotas and Minnesota.

10. **S. nana**, Nutt. A span to a foot high, canescent with minute dense puberulence, *not scabrous in age*: leaves mostly obovate or spatulate and entire, small: heads broad, few or rather numerous in an oblong or corymbiform panicle, *not at all secund*: bracts of the involucre oval or oblong, *very obtuse*: otherwise nearly as *S. nemoralis*. — *S. pumila*, of Fl. Colorado. From Wyoming to N. Arizona and Nevada.

* * * *Heads in a compact and corymbiform thyrsus or cyme: radical leaves mostly long-petioled and with prominent midrib.*

+ *Leaves not 3-nerved or smooth: heads over 30-flowered: rays 7 to 10, rather large.*

11. **S. rigida**, L. Somewhat cinereous with a short and dense, either soft or scabrous pubescence: stem stout, 2 to 5 feet high: leaves rigid, obscurely serrate or entire; radical and lowest cauline oval or oblong, rounded at both ends or acute at base, 3 to 7 inches long; upper cauline ovate-oblong, gradually smaller upward, with slightly clasping or decurrent base: clusters dense: heads campanulate: involucre bracts broad: akenes turgid, 12 to 15-nerved. — From Colorado to the Saskatchewan and eastward.

+ + *Leaves rigid, 3-nerved, smooth and glabrous: heads 5 to 8-flowered: rays 1 to 3, short.*

12. **S. pumila**, Torr. & Gray. Dwarf, a span or more high, many-stemmed from a woody caespitose caudex, glabrous throughout, punctate, somewhat resinous: radical leaves 2 or 3 inches long: cyme glomerate-fastigiate: heads narrowly oblong: involucre bracts rigid, somewhat carinate, and with small green tips: mature akenes flattish and 5 nerved. — From Texas through S. Colorado to Nevada and Idaho.

§ 2. *Receptacle fimbriate or pilose: rays very small, almost always more numerous than the disk-flowers and never surpassing them in height: heads glomerately and fasciculately cymose, small: leaves very numerous, all linear, entire, 1 to 5-nerved, sessile: akenes villos-pubescent.*

13. **S. occidentalis**, Nutt. Stems 2 to 6 feet high; the branches terminated by small clusters of mostly pedicellate heads: leaves usually 3-nerved, glabrous and smooth even on the midrib, and margins obscurely scabrous: bracts

of the involucre rather narrow: rays 16 to 20: disk-flowers 8 to 14. — Torr. & Gray, Fl. ii. 226. From New Mexico to Montana and westward.

14. *S. lanceolata*, L. *Comparatively low, cymosely much branched above and flat-topped, heads mostly glomerate-sessile: leaves lanceolate-linear, distinctly 3-nerved and the larger with an additional outer pair of more delicate nerves, minutely scabrous-pubescent on the nerves beneath: outer bracts of the involucre ovate or oblong: rays 15 to 20: disk-flowers 8 to 12.* — From Montana to Canada and Georgia.

12. TOWNSENDIA, Hook.

Depressed or low many-stemmed herbs of the Rocky Mountains: entire leaves from linear to spatulate: heads comparatively large, the numerous rays from violet or rose-purple to white: akene commonly beset with hairs which are forked or glochidiate-capitellate (i. e. bidentate at apex and the two lobes recurved or revolute, thus appearing minutely capitate).

* *Bracts of the involucre conspicuously attenuate-acuminate: head large: involucre $\frac{1}{2}$ inch or more high, and rays $\frac{1}{2}$ inch long.*

+ *Caulescent, somewhat hirsute-pubescent, but the foliage at length glabrate: involucre naked; its bracts from lanceolate to ovate-lanceolate: rays showy, bright blue or violet.*

1. *T. eximia*, Gray. Stems erect, simple or sparingly branching, 6 to 14 inches high: leaves spatulate or the upper lanceolate: head sparingly leafy-bracted or naked at base: involucre bracts ovate-lanceolate and somewhat rigidly cuspidate-acuminate, whitish-scarious with green centre: akenes broadly obovate, almost cartilaginous, glabrate, sprinkled with a few short and obscure glochidiate-tipped hairs: pappus wholly persistent, of 2 subulate at length corneous stout awns which are rather shorter than the akene, and a circle of rigid scales. — Pl. Fendl. 70. Mountain sides, New Mexico and Colorado.

2. *T. grandiflora*, Nutt. Stems spreading from the base, sometimes divergently branched above, a span or two high: upper leaves often linear, 2 or more uppermost subtending the head: involucre nearly of the preceding: akenes narrowly obovate, sprinkled with glochidiate-capitellate hairs: pappus in the ray reduced to a crown of short scales, and of the disk plurisetose and longer than the akene. — Plains and hills, Wyoming and W. Nebraska to New Mexico.

3. *T. Parryi*, Eaton. Stems erect, simple, stout, naked and pedunculiform above, 2 to 6 inches high: leaves mostly spatulate: bracts of the very broad involucre lanceolate, thinner, with softer and less attenuate tips, or the outer barely acuminate: akenes narrowly obovate, canescently pubescent, the hairs acute and simple or many of them 1 to 2-dentate at tip: pappus of the ray plurisetose like that of the disk, or somewhat more scanty. — Am. Naturalist, viii. 212. Wyoming, Montana, and E. Idaho.

Var. *alpina*, Gray. A dwarf and alpine form, more pubescent and cinereous: leaves very small, at most $\frac{1}{2}$ inch long: flowering stem about the same length or hardly any: involucre bracts less pointed: "rays pink." — Proc. Am. Acad. xvi. 83. Wyoming on the high divide between the Stinking Water and the Yellowstone, Parry.

← ← *Depressed-stemless and monocephalous.*

4. **T. condensata**, Parry. Very lanuginous with long and soft arachnoid hairs, the spatulate-ovate leaves rosulate-crowded around the large and broad sessile head, the whole forming a globular or hemispherical woolly tuft, an inch and a half high and surmounting a slender stoloniform caudex: bracts of the involucre linear and soft, with a weak attenuate apex, all nearly equal in length: rays 100 or more, narrow: pappus of ray and disk plurisetose and long. — Am. Nat. viii. 213. Wyoming, on a high alpine peak of the Owl Creek range, *J. D. Putnam*.

* * *Bracts of the involucre not prominently if at all acuminate: heads mostly smaller or narrower: pappus of the disk and often of the ray plurisetose.*

← *Hairs on the akene mostly copious and slender, simple or bifid, the lobes ascending or merely spreading: heads middle-sized, more or less naked-pedunculate: the pink or rarely white rays and the involucre each from $\frac{1}{2}$ to $\frac{1}{2}$ inch long.*

5. **T. florifer**, Gray. A span or more high, cinereous-hirsute: stems rather slender, leafy: leaves linear or the lowest lanceolate-spatulate, acute, mostly apiculate-acuminate: involucre bracts linear-lanceolate, little unequal. — Proc. Am. Acad. xvi. 84. Montana to Washington and Oregon.

← ← *Hairs on the akene mostly glochidiate-capitellate.*

++ *Head large, $\frac{3}{4}$ to 1 inch long without the rays: plants green and glabrous, depressed-acaulous: leaves large, much surpassing the head.*

6. **T. Wilcoxiana**, Wood. Leaves linear-spatulate, elongated, 1 to 3 inches long including the petiole-like base: head mostly solitary, short-peduncled or subsessile: bracts of the involucre lanceolate or linear, barely acutish: ray and disk pappus of similar slender and elongated bristles. — Bull. Torr. Club, vi. 163; Bot. Gazette, iii. 50. Colorado to Arizona and Indian Territory.

7. **T. Rothrockii**, Gray. Leaves more broadly spatulate and shorter, an inch long or less, rosulate around the solitary head which is closely sessile at the surface of the ground, or at length with one or two additional heads: involucre shorter and broader; its bracts oblong, mostly obtuse: ray-pappus of chaffy bristles not longer than the breadth of the akene. — Wheeler Rep. vi. 148. In the alpine regions of the mountains of South Park, Colorado.

++ ++ *Heads from $\frac{1}{2}$ to $\frac{3}{4}$ inch long, sessile or rarely on a very short naked peduncle: plants sericeous-pubescent, depressed-acaulous or -caulescent: ray-pappus mostly plurisetose.*

8. **T. sericea**, Hook. Depressed-acaulous, with closely sessile solitary or few heads on the crown next the ground, surrounded and more or less surpassed by the linear or linear-spatulate leaves, an inch or two high: heads an inch or less long: involucre bracts narrowly lanceolate, acute: rays white or purplish: ray and disk of pappus mostly similar. — From New Mexico and Arizona northward in the mountains to British America. Exceedingly variable.

Var. **leptotes**, Gray, has heads less than $\frac{1}{2}$ inch long, all but the primary ones distinctly pedunculate, and the leaves narrowly linear with attenuate base. — Middle Park, Colorado, *Parry*.

9. **T. incana**, Nutt. Depressed-caulescent or subcaulescent, an inch to a span high, branching: leaves from narrowly spatulate to almost linear;

uppermost around the sessile ($\frac{1}{2}$ inch) heads and *seldom surpassing them*: involueral bracts more obtuse: pappus of the ray from $\frac{1}{4}$ to $\frac{1}{2}$ the length of that of the disk. — Mountains of Wyoming to Utah and Nevada.

++ ++ Heads about $\frac{1}{2}$ inch long: sessile among the rosulate leaves: herbage soft-lanate: pappus deciduous in a ring.

10. **T. spathulata**, Nutt. Depressed and multicapital, forming a tuft an inch or so high: leaves crowded, spatulate, densely villous-lanate; the upper about equalling the heads: bracts of the involucre oblong-lanceolate, acute: rays rather short, pinkish: pappus of ray and disk similar, of slender bristles. — Mountains of Wyoming.

++ ++ ++ Heads small, $\frac{1}{4}$ inch high (exclusive of the rays), mostly short-pedunculate: involucre of broadly lanceolate and barely acute bracts: caulescent and branching: pappus of the ray shorter, commonly of chaffy bristles.
= Green and glabrate.

11. **T. glabella**, Gray. An inch or two high, nearly simple, sparsely pilose-pubescent when young: leaves thickish, soon glabrous, spatulate, an inch or less long, including the usually slender petiole; the uppermost usually surpassed by the slender and naked peduncle: involucre glabrous. — Proc. Am. Acad. xvi. 86. S. W. Colorado, Newberry.

= Cinereous with fine and close pubescence, flowering from near the ground at first, but becoming taller (4 to 10 inches high) and loosely branching.

12. **T. Fendleri**, Gray. Leaves linear: bracts of the involucre unequal, in about 3 ranks, acute. — Pl. Fendl. 70. New Mexico and S. Colorado.

13. **T. strigosa**, Nutt. Flowering when only $\frac{1}{2}$ inch high, often attaining a span in height: early leaves spatulate; later ones linear: heads rather smaller: bracts of the involucre broader, acutish, in about 2 ranks, the outer shorter. — Wyoming to New Mexico and Arizona.

13. ASTER, Tourn. STARWORT. ASTER.

The largest and by far the most difficult of our genera, not naturally separated from *Erigeron*. All are herbs, mostly perennial, and especially characteristic of North America. Includes *Machueranthera* and *Diplopappus*.

§ 1. Involucral bracts (at least the outer ones) with green herbaceous tips or appendages, or wholly or partly foliaceous, imbricated or many-ranked, their margins not scarious: akenes from obovate-oblong to linear, 3 to several-nerved: pappus rather fine and soft (in one or two species more coarse and rigid), simple (with no exterior series). — ASTER proper.

* Involucre well imbricated: the bracts appressed and coriaceous, with more or less spreading herbaceous tips: akenes narrow, 5 to 10-nerved: pappus more rigid than in the following groups: rays showy, blue or violet: leaves firm, acutely serrate, more or less scabrous, none of them cordate or clasping; the radical tapering at base into margined petioles.

1. **A. Sibiricus**, L. A span to a foot high, somewhat cinereous-pubescent or puberulent, or the foliage scabrous: heads solitary, terminating the stem or corymbiform branches: leaves oblong-spatulate to broadly lanceolate, 1 to 3 inches long: involucre 3 lines high, shorter than the disk; its bracts narrowly

lanceolate, with mostly acute and loose herbaceous tips: rays 3 or 4 lines long, violet: *akenes pilose-pubescent*. — Mountains of Wyoming and Montana, and far northward.

2. **A. conspicuus**, Lindl. Scabrous: stem 2 feet high, stout, rigid, bearing several or numerous corymbosely cymose heads: leaves rigid, ovate, oblong, or the lower obovate, ample, 4 to 6 inches long: involucre about equalling the disk, 5 to 6 lines high; its bracts in several series, minutely glandular-puberulent, lanceolate, acute, the greenish tips little spreading: rays $\frac{1}{2}$ inch long, violet *akenes minutely pubescent*. — In the mountains, from the Yellowstone northward.

* * Involucre and usually branchlets viscidly-glandular, rather well imbricated: rays 15 to 40, showy, violet to purple: *akenes* narrow, several-nerved: leaves all entire or the lower with few teeth; caudine all sessile or partly clasping.

+ Stem simple: leaves and heads proportionally large: alpine or subalpine.

3. **A. integrifolius**, Nutt. Stem a foot or more high, stout, sparsely leafy, villous-pubescent but glabrate, bearing few or several racemed or thyrsoid heads: leaves firm, oblong to spatulate, 4 to 7 inches long; the smaller upper ones lanceolate, half-clasping; lowest tapering into a long winged petiole: heads $\frac{1}{2}$ inch high: involucre and branchlets viscid-glandular; its bracts linear, not squarrose: rays bluish purple. — From Colorado to Montana and westward.

4. **A. Kingii**, Eaton. A span or less high, caespitose: leaves mainly radical, spatulate, entire, or with few sharp teeth, mucronate, thinish, glabrous or nearly so, 1 to 3 inches long: flowering stems pubescent and above glandular, bearing solitary or 3 to 5 middle-sized heads: involucre 4 or 5 lines high, merely puberulent-glandular, hardly at all viscid; the bracts linear-lanceolate with attenuate and squarrose-spreading green tips: rays white — Bot. King Exp. 141. In the Wasatch Mountains.

+ + Stems branching: leaves comparatively small: neither alpine nor subalpine.

+ + Involucre of the small and scattered heads not squarrose; the green tips of the bracts more or less erect: slender and low species, a span to a foot or less high.

5. **A. campestris**, Nutt. Pruinoso-puberulent and viscidulous, somewhat heavy-scented: leaves linear, about an inch long, a line or two wide, or lower narrowly spatulate, mostly glabrate, some obscurely 3-nerved: involucre 3 or 4 lines high, hemispherical, of rather few-ranked and little unequal linear acute bracts: rays 3 or 4 lines long, light violet or purple — From Montana and Idaho to Washington and California.

6. **A. Fendleri**, Gray. Rigid, a span to a foot high, sparsely hispidulous: the linear one-nerved firm leaves hispid-ciliate, otherwise usually smooth and glabrous: involucre somewhat campanulate, 3 lines high; outer bracts shorter, linear-oblong, obtuse, pruinose-glandular: rays violet, 4 lines long. — Pl. Fendl. 66. *A. Nuttallii*, var. *Fendleri*, Gray. Plains and sand-hills, from W. Kansas to S. Colorado and N. New Mexico.

+ + + Involucre of middle-sized heads well imbricated; the unequal bracts with loose squarrose-spreading tips: leaves not rigid, spreading.

7. **A. Novæ-Angliæ**, L. Stem stout and strict, 2 to 8 feet high, very leafy to the top, coarsely hirsute or hispid with many-jointed hairs, also with glandular

pubescence: leaves lanceolate or broadly linear, *pubescent*, 2 to 5 inches long, entire, slightly if at all narrowed below, half-clasping by a strongly auriculate-cordate base: *heads crowded*: *rays* 50 to 60 or more, fully half-inch long, *purple*. — From Colorado to the Saskatchewan and eastward.

Var. *roseus*, DC. Rays rose-colored. — Occasionally with the ordinary form.

8. *A. oblongifolius*, Nutt. About 2 feet high: stem *hirsute-pubescent*, very leafy, *corymbosely branched*: leaves from narrowly oblong to broadly linear, larger cauline 2 inches long, *somewhat puberulent*: involucre aromatic-scented, the linear bracts *granulose-glandular* and *viscidulous*: *rays* 25 to 30, *bright violet*, 5 or 6 lines long. Hardly within our range, but represented in Colorado by

Var. *rigidulus*, Gray. Low, more fastigiate, with more rigid and hispidulous scabrous leaves. — Synopt. Fl. i. 179.

* * * *Heads small, paniculate*: lower cauline and radical leaves *cordate* and *petioled*: no glandular or viscid *pubescence*: *akenes compressed*, 3 to 5-nerved: *rays violet, purplish, or white*.

9. *A. sagittifolius*, Willd. Green, from glabrous to sparsely pilose-pubescent: stem strict, 2 or 3 feet high: leaves oblong- and ovate-lanceolate, acutely more or less serrate; radical and lowest cauline narrowly cordate, on naked petioles; upper subcordate or truncate at base and contracted into a winged petiole, 3 to 5 inches long; uppermost linear-lanceolate and sessile: heads densely thyrsoïd-paniculate: bracts of the involucre subulate-linear and mostly attenuate, the tips rather loose. — In the Dakotas within the eastern limit of our range, and extending eastward.

* * * * *No cordate petioled leaves*; radical leaves all *acute* or *attenuate* at base: not glandular nor viscid nor silky-canescens: *akenes compressed, few-nerved*.

+ Whole plant very smooth and glabrous: heads rather large, showy, with firm closely imbricated appressed green-tipped bracts: leaves on flowering branchlets mostly reduced to rigid subulate bracts: *akenes glabrous*.

10. *A. lævis*, L. Rather stout, 2 to 4 feet high, rigid: leaves from ovate or oblong to lanceolate, 4 or 5 inches long, decreasing upward; radical and lowest cauline contracted below into a winged petiole; upper all with auriculate or subcordate partly clasping base: heads sparsely thyrsoïd-paniculate, on short and rigid branchlets: involucre campanulate or obscurely turbinate; the whitish coriaceous bracts bearing abrupt rhomboid or deltoid short green tips: rays 20 or 30, broadish, sky-blue verging to violet. — Eastern slopes of the Rocky Mountains and eastward across the continent.

Var. *Geyeri*, Gray. A foot or two high: involucre broader and less imbricated; its bracts of thinner texture, mostly attenuate-acute, the green tip less definite. — Synopt. Fl. i. 183. In the mountains of Idaho and Wyoming and northward.

+ + *Heads rather small* (3 or 4 lines high), *thyrsoïdly* or *corymbosely* arranged; bracts rigid, narrow, with subulate green nearly erect tips: rays numerous, bright white, 4 lines long: *akenes minutely pubescent*.

11. *A. Porteri*, Gray. A foot or less high, glabrous and smooth (except ciliation of lowest leaves), either simple or branching above: leaves linear or

lower spatulate-linear, 2 to 4 inches long, 1 to 3 lines wide; radical spatulate: heads broad: involucre bracts linear-subulate; outer little shorter than inner. — Proc. Am. Acad. xvi. 99. *A. ericoides*, var. *strictus*, Porter, Fl. Colorad. 56. Common in the Colorado Rocky Mountains.

+ + + *The numerous small heads racemously arranged: unequal bracts well imbricated, with squarrose or at least spreading herbaceous obtuse or merely mucronate tips: cauline leaves small, linear and entire, scarcely narrowed at the abrupt sessile or partly clasping base: akenes canescent-hirsute: rays white, rarely tinged with blue or purple.*

12. **A. multiflorus**, Ait. Low, a foot or two high, bushy-branched, cinereous or green: leaves rigid, scabrous-ciliate; uppermost passing into involucre bracts; these mostly with obtuse tips: heads in the ordinary forms little over 2 lines long, and with only 10 to 15 or 20 rays. — From Arizona to British Columbia and eastward across the continent.

13. **A. commutatus**. A foot or so high, with divergent branches: heads more scattered and twice or even thrice the size of those of *A. multiflorus*, 3 or 4 lines high and broad: rays 20 to 30: otherwise nearly as the preceding. — From Saskatchewan and the Dakotas to Utah and E. Oregon.

+ + + + *Involucre in some imbricated and with short close tips, in others more loose and herbaceous: heads when numerous either thyrsoïd or open-paniculate on erect or ascending branches.*

+ + *Cauline leaves sessile, but neither with cordate or auriculate base (with 1 or 2 exceptions), nor with abrupt winged petiole-like lower portion.*

= *Herbage inclined to be glabrous; the branches often pubescent in lines: leaves (at least some of them) serrate or denticulate: stems branching and with several to many heads: none alpine or subalpine: Eastern forms.*

a. *Involucre close and erect; its bracts imbricated in successive lengths.*

14. **A. paniculatus**, Lam. Stem 2 to 8 feet high, freely and paniculately branched: leaves from elongated oblong to narrowly lanceolate, mostly attenuate-acuminate, sharply serrate or denticulate, or upper entire, thin: heads about $\frac{1}{2}$ inch high, in loose and open mostly leafy panicles: bracts of the involucre narrowly linear, with tapering acute or acuminate green tips: rays 3 or 4 lines long, white varying to purplish or violet. — A very polymorphous species, including also part of the forms heretofore included under *A. Tradescanti*, *simplex*, *tenuifolius*, and *carneus*. From E. Montana to Louisiana and eastward; abundant in the Northeastern States.

15. **A. salicifolius**, (Lam ?) Ait. Resembles the preceding, equally branching: leaves commonly less elongated, less serrate or entire, of firmer texture, apt to be scabrous, and the fine reticulation of the veinlets manifest: involucre more imbricated; its bracts firmer, linear, with shorter and more definite green tips, these acute or obtusish: heads disposed to be thyrsoïd or racemose-glomerate on the ascending branches: rays purplish to violet, rarely white. — Includes *A. carneus*, in part. From E. Montana to Texas and northeastward; most abundant in the Mississippi Valley.

b. *Involucre loose, and less imbricated; its bracts about equal.*

16. **A. junceus**, Ait. Slender, 1 to 3 feet high, the smaller plants simple-stemmed and with few heads, smooth and nearly glabrous: leaves linear or

nearly so, 3 to 5 inches long, 2 to 4 lines wide, entire, or lower with rare denticulations: involucre 3 lines high; its bracts all small, narrowly linear and erect, thinnish, manifestly imbricated in 2 or 3 series, and the outer more or less shorter (thus connecting with *A. paniculatus* of the preceding subdivision): rays light violet-purple, 4 or 5 lines long. — *A. ceticus*, Gray, Man. mainly. Wet meadows in the mountains north to the British possessions, and thence eastward.

17. *A. longifolius*, Lam. A foot to a yard high, glabrous or pubescent, leafy: leaves elongated-lanceolate to linear-lanceolate, entire or sparingly serrulate, 3 to 7 inches long, tapering to both ends: involucre 4 or 5 lines high, little or not at all imbricated; its bracts all of nearly equal length: rays 3 or 4 lines long, violet or purplish, rarely almost white. — Low moist grounds, Montana to Labrador, and south to New England.

= = Inclined to be pubescent or scabrous, at least in the upper parts of the stem, which is often monocephalous: leaves entire or nearly so: frequently alpine or subalpine: Western forms.

a. Involucre conspicuously and regularly imbricated, of oblong-linear or spatulate bracts; outer bracts successively shorter; all loosely erect or little spreading, with mostly obtuse and broadish tips.

18. *A. adscendens*, Lindl. A span to two feet high, rather rigid, from nearly glabrous to strigulose: stems commonly branching bearing few or rather numerous loosely paniculate or subcorymbose heads (4 or 5 lines high): leaves of firm and thickish texture, linear to spatulate-lanceolate, with margins commonly ciliate or scabrous: bracts of the hemispherical involucre moderately unequal and in comparatively few ranks: rays 3 or 4 lines long, violet or purple. — From New Mexico and Arizona to Nevada, Montana, and the Saskatchewan.

b. Involucre more or less imbricated but looser; the bracts all narrow (linear or subulate), thinnish, from moderately to hardly unequal, loosely erect, mostly acute, with not at all broadened tips, nor with the outermost foliaceous.

1. Low, 1 to 2 feet high or less, with solitary or few heads: chiefly in the mountains and northward.

19. *A. Andinus*, Nutt. Dwarf, with decumbent stems 2 or 3 inches long from filiform creeping rootstocks; bearing a solitary comparatively large head: leaves $\frac{1}{2}$ inch long; radical and lower cauline spatulate; cauline (2 or 3) linear-lanceolate; heads 4 lines high: rays (35 to 40) violet. — In the mountains of Wyoming, near perpetual snow, Nuttall. Not since found; thought possibly to be an alpine state of the following.

20. *A. Fremonti*, Gray. A span to a foot or more high, glabrous or nearly so: stem slender, erect: leaves with margins either quite naked and smooth or obscurely scabrous; radical and lowest cauline oblong or oblanceolate, or somewhat obovate, inch or two long, and tapering into a slender margined petiole; cauline from oblong-lanceolate to linear, commonly half-clasping at base: heads solitary in the smaller specimens, several in the larger, one third to half an inch high, somewhat naked-peduncled: bracts of the involucre narrowly linear, some of the outer shorter. — Synopt. Fl. i. 191. *A. adscendens*, var. *Fremonti*, Torr. & Gray. In the mountains below the alpine region from Colorado to Montana and westward to the Sierra Nevada and Cascades.

2. *Tall, 3 to 8 feet high, paniculately polycephalous: in low grounds and to the south.*

21. **A. hesperius**, Gray. From nearly glabrous and smooth to scabrous-pubescent: leaves lanceolate, entire or the larger with a few denticulations, 2 to 5 inches long, 3 to 8 lines wide: heads rather crowded, 4 or 5 lines high: involucre of narrowly linear or more attenuate erect bracts, either unequal and imbricated, or with some loose and slender exterior ones which equal the inner: rays either white or violet, 3 or 4 lines long. — Synopt. Fl. i. 192. S. Colorado and New Mexico to Arizona and S. California. Has been taken for *A. longifolius*, *Novi-Belgii*, *vestitus*, etc.

- c. *Involucre loose and with conspicuous foliaceous outer bracts, which equal the inner, either ascending or squarrose.*

22. **A. foliaceus**, Lindl. Smooth and glabrous, or upper part of stem pubescent: leaves from broadly lanceolate to oblong and the lower spatulate; upper cauline very commonly with partly clasping and sometimes even subcordate-auriculate base: heads $\frac{1}{2}$ inch high: involucre with lanceolate or broadly linear outer bracts: rays violet or purple, in the larger heads nearly $\frac{1}{2}$ inch long. — In the Pacific States from California to Alaska, extending eastward into our range under the following forms.

Var. **frondeus**, Gray. Stem simple or with sparing erect flowering branches, sparsely leaved: leaves comparatively ample, 4 or 5 inches long; lower tapering into winged petioles, upper often with clasping base: heads solitary or few, naked-pedunculate, broad: involucre bracts linear-lanceolate, loose and not imbricated, all equalling the disk, occasionally the outermost broader and leaf-like. — Synopt. Fl. i. 193. *A. adscendens*, var. *Parryi*, Eaton. Subalpine, from the borders of British Columbia to those of Colorado.

Var. **apricus**, Gray. Like a dwarf state of the preceding variety, growing in exposed places, somewhat rigid, thicker-leaved: stems ascending from tufted rootstocks, a span or two high, bearing solitary or 2 to 3 broad heads: involucre bracts all alike, somewhat spatulate-linear, obtuse or acutish: rays "deep blue-violet and reddish-purple intermixed." — Loc. cit. High mountains of Colorado, and in Washington.

Var. **Parryi**, Gray. Includes some ambiguous forms, seemingly between the preceding variety and *A. Fremonti*, with stems a span to a foot high, with smooth and thickish rather large leaves, mostly naked heads; the involucre sometimes foliaceous-bracteate in the manner of the present species, sometimes wholly of the narrow and closer bracts of *A. Fremonti*. — Loc. cit. Mountains of Colorado, subalpine, and S. Wyoming.

Var. **Burkei**, Gray. A foot or two high, rather stout, simple or branched above, leafy to the top: leaves thickish, very smooth, ample; upper cauline mostly oblong, and with broadly half-clasping usually auriculate insertion: heads solitary or several, very broad: involucre of oblong or spatulate and obtuse loosely imbricated bracts, the outer commonly shorter, or outermost sometimes more foliaceous and equalling the disk. — Loc. cit. Rocky Mountains, *Burke*; also in Washington, the Wasatch, New Mexico, and Arizona.

Var. **Canbyi**, Gray. Like the preceding form in foliage, apparently tall and stout (base of stem and lower leaves wanting), leafy throughout the

thyrsoid panicle of numerous subsessile heads: upper leaves rather broadly oblong and with broad half-clasping base obscurely auriculate: bracts of the involucre imbricated, with small and erect lanceolate green tips, only in some heads a few of the outermost loose and foliaceous, but seldom equalling the disk. — Loc. cit. *A. Canbyi*, Vasey. On White River in Western Colorado, Vasey.

Var. **Eatoni**, Gray. Rather tall, 2 or 3 feet high, branching, bearing numerous and smaller paniculate or glomerate heads, and comparatively narrow lanceolate leaves: involucre loosely imbricated; outer and sometimes inner bracts foliaceous, either erect or squarrose-spreading. — Loc. cit. 194. British Columbia to California and northeastward to Montana.

++ ++ *Base of most of the cauline leaves auriculate- or cordate-clasping.*

23. **A. puniceus**, L. Stem commonly 3 to 7 feet high, loosely branching above, rather stout, often red or purple, hispid with spreading bristles: leaves 3 to 6 inches long, oblong-lanceolate, acuminate, from coarsely and irregularly serrate to sparingly denticulate or sometimes entire, commonly scabrous above and often hispid along the midrib beneath: heads (4 to 6 lines high) subsessile, either sparsely paniculate or thyrsoid-crowded: involucre of loose and thin soft and narrowly linear merely herbaceous bracts: rays $\frac{1}{2}$ inch long, violet, varying to purple or occasionally white. — Throughout the Eastern States and extending into our range through the Dakotas.

§ 2. *Pappus double: involucre bracts narrow and appressed, well imbricated: rays 10 to 18, violet: akenes narrow, villous: low and tufted plants, with rigid stems thickly beset with small linear or lanceolate entire and rigid leaves.* — LANTHÆ.

* *Head $\frac{1}{2}$ inch high, broad, solitary: akenes flat, with strong nerves.*

24. **A. scopulorum**, Gray. Puberulent and somewhat cinereous: stems tufted, rigid, only a span high, terminated by a solitary pedunculate head: leaves short, 3 to 6 lines long, rigid, from oblong to linear or the lowest spatulate, the broader obtuse with an abrupt mucro, callous-margined: involucre broadly campanulate; its bracts imbricated in about 3 series, scabro-puberulent, lanceolate: rays $\frac{1}{2}$ inch long, light violet: outer pappus sometimes distinctly chaffy. — Proc. Am. Acad. xvi. 98. *Diplepappus alpinus*, Nutt. Mountains of Montana and Wyoming to Nevada and California.

25. **A. stenomerus**, Gray. More slender, 6 to 10 inches high, green, minutely scabrous: solitary naked pedunculate head larger: leaves all linear, $\frac{1}{2}$ to 1 inch long, a line wide, acutely mucronate, hardly margined: involucre broad; its bracts barely in two moderately unequal series, linear, thinish, often pubescent: rays pale violet, over $\frac{1}{2}$ inch long: outer pappus setulose. — Proc. Am. Acad. xvii. 209. — Mountains of Montana and Idaho.

* * *Heads $\frac{1}{2}$ to $\frac{1}{4}$ inch high, narrow: akenes less compressed, lightly few-nerved: outer pappus of few or indistinct unequal short bristles.*

26. **A. ericæfolius**, Rothrock. About a span high, canescent and glandular-scabrous, much branched: branches erect or diffuse, terminated by somewhat pedunculate heads: leaves commonly hispid-ciliate, erect or little spreading, 3 to 6 lines long; lowest spatulate and tapering into a petiole;

upper from linear to nearly filiform: bracts of the involucre in about 3 series, lanceolate, acute or apiculate, thinnish, scarious margined: rays purple or violet, sometimes white. — Bot. Gazette, ii. 70. *Diplopappus ericoides*, Torr. & Gray. From Kansas and Texas to Utah, Arizona, and California.

§ 3. *Pappus simple: bracts of the involucre imbricated and appressed, destitute of foliaceous or herbaceous tips, often scarious-edged or more or less dry: rays fertile: leaves mostly entire.* — ORTHOMERIS.

* *Involucre well imbricated, of small and narrow bracts, greener than in others of this section: low and slender herbs, leafy-stemmed, branching above; with linear erect leaves, and several small white-rayed heads: akenes not compressed, very glabrous.*

27. **A. ptarmicoides**, Torr. & Gray. Rather rigid, 6 to 20 inches high in a tuft, from smooth to puberulent, bearing a corymbiform cyme of several or numerous heads: leaves firm, linear or the lower spatulate-lanceolate: bracts of the involucre oblong-lanceolate, obtuse, thickish, rather rigid: rays 2 to 4 lines long, broadish: pappus white, of rather rigid bristles, longer ones manifestly clavellate at tip. — From Colorado to the Saskatchewan and New England.

* * *Involucre appressed-imbricated in several series of ovate or ovate-lanceolate dry chartaceous bracts: akenes compressed, more or less pubescent: stems leafy, bearing several or solitary pedunculate heads.*

+ *Involucral bracts thin, acute, commonly tomentose (at least when young): akenes hirsute, becoming glabrate: heads showy, 4 to 6 lines high.*

28. **A. Engelmanni**, Gray. Rather tall and robust, green, puberulent to glabrous: leaves thin, ovate-oblong to broadly lanceolate, 2 to 4 inches long, the larger sometimes with a few small teeth, upper acuminate: heads $\frac{1}{2}$ inch high: involucral bracts acute or acuminate; some outer ones partly herbaceous, or with loose pointed tips; inner purplish: rays $\frac{1}{2}$ inch long. — Am. Jour. Sci. 11. xxxiii. 238. *A. elegans*, var. *Engelmanni*, Eaton. Mountains of Colorado, Utah, and Wyoming, to the Cascades.

29. **A. elegans**, Torr. & Gray. Slender, 1 to 3 feet high, mostly scabro-puberulent: leaves thickish, pale, lanceolate, inch or two long, erect, the upper apiculate-mucronate: heads several at summit of simple stem or branches, comparatively small and few-flowered, 4 or 5 lines high: involucral bracts all close and conspicuously woolly-ciliate, barely acute, outer ovate, none with pointed tips: rays rather few, about 4 lines long. — Fl. ii. 159. Mountains of Wyoming and Montana to Nevada and Oregon.

+ + *Involucral bracts firmer, glabrous, all the outer obtuse: akenes merely pubescent: heads smaller, 3 lines high.*

30. **A. glaucus**, Torr. & Gray. Throughout smooth and glabrous, glaucescent or pale: stems a foot high from extensively creeping filiform rootstocks, branching, bearing several or numerous paniculate heads: leaves thickish, lanceolate, 1 to 3 inches long, $\frac{1}{4}$ to $\frac{1}{2}$ inch broad, rather obtuse: involucre imbricated in about 3 ranks: rays bright violet, 4 to 6 lines long. — Fl. ii. 150. Mountains of Wyoming to Colorado and Utah.

* * * *Involucre less imbricated, hemispherical; the bracts partly greenish, in few ranks, with or without scarious margins: low-stemmed or acaulescent, from a thick rootstock, with solitary or few pedunculate heads, $\frac{1}{2}$ inch or more high: leaves thickish and narrow.*

+ Heads terminating short leafy stems which arise from creeping and woody rootstocks: involucre bracts acuminate and mucronate-tipped: akenes oblong, very villous.

31. **A. Parryi**, Gray. *Tomentose-pubescent and cinereous, a span high: leaves mostly spatulate and obtuse with a mucronate point, an inch or more long: heads usually solitary on peduncle surpassing the leaves, very broad: bracts of the involucre oblong-lanceolate, densely cinereous-pubescent: rays white, over $\frac{1}{2}$ inch long.* — Am. Nat. viii. 212. Mountains of Wyoming.

32. **A. Xylorrhiza**, Torr. & Gray. *Less pubescent and glabrate, 4 to 8 inches high: leaves from narrowly spatulate-lanceolate to linear, 1 or 2 inches long, 1 to 3 lines wide; the upper commonly equalling the 1 to 3 peduncles: heads smaller: involucre bracts more attenuate: rays "pale red" or "pale rose-color," 4 lines long.* — Mountains of Wyoming.

+ + Heads (large for the plant) solitary on simple and scapiform stems, which with the cluster of narrow radical leaves rise from a thickened caudex: involucre bracts acutish: akenes linear, glabrate: pappus strongly denticulate.

33. **A. pulchellus**, Eaton. Stems 2 to 4 inches long: radical leaves from spatulate to narrowly linear, 1 to 2 inches long, obtuse, in our form only a line wide: akenes striate. — Bot. King. Exp. 143. Alpine from Wyoming and Montana to Oregon and Washington.

* * * * *Involucre little imbricated, with peduncles and upper part of stem viscid-glandular: heads $\frac{1}{4}$ inch high, with conspicuous violet or purple rays.*

34. **A. pauciflorus**, Nutt. Stem 6 to 20 inches high from a slender creeping rootstock, simple and bearing few heads, or branching above: leaves moderately fleshy, linear, or radical subspatulate or elongated-lanceolate, uppermost reduced to bracts: bracts of short hemispherical involucre rather fleshy and green, moderately unequal and rather loose, in only 2 or 3 ranks: akenes narrow, compressed, striate-nerved, appressed-pubescent. — In saline soil from New Mexico and Arizona to Utah, and eastward to the Dakotas and Saskatchewan.

§ 4. *Involucre of 2 or 3 series of linear nearly equal bracts; the outer foliaceous, resembling the upper leaves: ray-flowers with the ligule generally wanting: akenes narrow, not compressed, appressed-pubescent: pappus simple, very soft.* — CONYZOPSIS.

35. **A. angustus**, Torr. & Gray. A span to a foot high, branching, leafy-stemmed, nearly glabrous, except that the linear chiefly entire leaves are somewhat ciliate: numerous rather small heads disposed to be racemose-paniculate: bracts of the involucre acute: corolla of the ray-flowers reduced to the tube and much shorter than the elongated style. — Fl. ii. 162. Wet saline soil from Colorado and Utah to the Saskatchewan and Minnesota.

§ 5. *Involucre imbricated in many rows; the bracts linear, coriaceous below, with foliaceous spreading tips: rays numerous and conspicuous, violet or bluish purple: akenes narrowed downward, compressed: receptacle honeycombed:*

pappus copious and simple, of rather rigid and unequal bristles: leafy-stemmed and branching, the showy heads terminating the branches, the involucre canescent or even viscid, and the leaves from dentate to bipinnately-parted.

— *MACHÆRANTHERA*.

- * *Involucre densely hispidulous as well as viscid, very squarrose: akenes glabrous or glabrate: leaves from incisely dentate to entire, the teeth hardly at all bristle-tipped: rays bright violet.*

36. **A. Pattersoni**, Gray. A span or two high, branched from the summit of the tap-root: stems or branches with soft or cottony pubescence or glabrate: leaves thickish, spatulate or lingulate, entire or coarsely few-toothed, none widened at base: heads solitary or few: involucre bracts lanceolate: rays about 30, fully $\frac{1}{2}$ inch long. — Proc. Am. Acad. xiii. 272. *Machaeranthera canescens*, var. *alpina*, Porter, Fl. Colorad. 59. Moist ground along streams, Gray's Peak, Colorado.

37. **A. Bigelovii**, Gray. A foot or two high, robust: stem leafy, branching above, roughish-hirsute to glabrate; the flowering branches or peduncles glandular-hirsute, terminated by showy large heads: leaves oblong or lanceolate, irregularly and sometimes incisely dentate, sometimes entire; radical lanceolate-spatulate; cauline oblong to lanceolate, usually with broadish partly clasping base: involucre bracts very numerous, linear-attenuate or the prolonged and much recurved tips almost filiform: rays very many, an inch or less long. — Pacif. R. Rep. iv. 97. Colorado and New Mexico.

- * * *Involucre from nearly glabrous to glandular-puberulent, but not hispidulous: akenes densely pubescent or villous: leaves generally with bristle-tipped teeth.*

+ *Leaves at most incisely dentate.*

38. **A. Coloradoensis**, Gray. A span or less high, forming a tuft of short few-leaved stems on a strong tap-root, canescently pubescent, not at all glandular: leaves spatulate or oblanceolate, about an inch long, coarsely dentate, the teeth tipped with conspicuous bristles: heads solitary, broadly hemispherical, $\frac{1}{2}$ inch high: involucre bracts small and numerous, well imbricated, subulate-lanceolate: rays 35 to 40, violet-purple, barely $\frac{1}{2}$ inch long: akenes densely canescent-villous, $\frac{1}{2}$ the length of the comparatively rigid pappus. — Proc. Am. Acad. xi. 76. Common in South Park, Colorado, and at the San Juan Pass.

39. **A. canescens**, Pursh. Commonly a foot or two high and loosely much branched, bearing numerous paniculate heads, sometimes dwarf and with simple contracted inflorescence, pale and cinereous-puberulent or minutely caescent, or greener and glabrate: leaves lanceolate to linear, or the lower spatulate, from entire to irregularly dentate, or occasionally lacinate, the rigid teeth mostly with mucronate tip: involucre of rigid usually well-imbricated bracts: rays violet, 4 or 5 lines long: akenes narrow, canescent. — Fl. ii. 547. *Machaeranthera canescens* and *M. pulverulenta* of the Western Reports. A polymorphous species. From Arizona to Texas and northward to British Columbia and the Saskatchewan.

Var. **latifolius**, Gray. Green, minutely soft-pubescent, 2 feet or more high: leaves thinnish, nearly membranaceous, comparatively large, sometimes spatulate-oblong, and over $\frac{1}{2}$ inch wide: heads large and few: involucre hemispherical; tips of its bracts mostly attenuate-subulate and squarrose-

spreading, canescent and obscurely glandular. — Synopt. Fl. i. 206. *Machaeranthera canescens*, var. *latifolia*, Gray. New Mexico, Arizona, and Colorado.

Var. *viscosus*, Gray. Canescent or cinereous: leaves narrow, rather rigid; the upper mostly entire, the lower coarsely dentate: involucre campanulate or turbinate, squarrose; the prominent foliaceous tips of the bracts viscid-glandular, either spreading or recurved. — Loc. cit. Wyoming to California.

+ + Leaves 1 to 3-pinnately cleft or parted: involucre hemispherical, its bracts mostly looser: stem diffusely branched.

40. *A. tanacetifolius*, HBK. Pubescent or viscid, very leafy, a foot or two high: lowest leaves 2 to 3-pinnately parted; uppermost simply pinnatifid or on the flowering branchlets entire: heads $\frac{1}{2}$ inch high: bracts of the involucre narrowly linear, with slender mostly linear-subulate spreading foliaceous tips, or the outermost almost wholly foliaceous: rays numerous, $\frac{1}{2}$ inch long or more, bright violet: akenes rather broad, villous. — *Machaeranthera tanacetifolia*, Nees. From Nebraska to Texas and westward to Arizona and California.

14. ERIGERON, L. FLEABANE.

Heads disposed to be solitary and long-pedunculate; rays variously colored; disk-flowers yellow, not changing to purple: akenes generally 2-nerved.

§ 1. Rays elongated and conspicuous, wanting in a few species, occasionally abortive in one or two: no rayless female flowers between the proper ray and disk. — EUERIGERON.

* Commonly dwarf from a multicapital caudex, alpine or subalpine, with rather large and mostly solitary heads: involucre loose and spreading, and copiously lanate: rays about 100, narrow: leaves entire.

1. *E. uniflorus*, L. Stems an inch to a span or two high, few-leaved, often naked and pedunculiform at summit: radical leaves spatulate or oblanceolate, inch or two long; cauline lanceolate to linear: involucre usually hirsute as well as lanate, occasionally becoming naked; the linear acute bracts rather close, or merely the short tips spreading: rays purple or sometimes white, 2 or 3 or rarely 4 lines long. — Alpine, from Colorado and California northward and across the continent in high latitudes.

2. *E. lanatus*, Hook. Stems about a span high, scapiform or few-leaved: radical leaves spatulate to obovate, about $\frac{1}{2}$ inch long, tapering into a narrowed base or into a slender margined petiole; some primary ones occasionally palmately 3-lobed; cauline one or two, small and linear, or hardly any: head not larger than that of the last, and involucre similar, but densely soft-lanate: rays rather broader, 3 lines long, white. — Alpine in Montana and British Columbia.

3. *E. grandiflorus*, Hook. Stems a span or two high, rather stout, usually several-leaved: radical leaves obovate-spatulate, an inch or so long; cauline oblong to lanceolate, usually $\frac{1}{2}$ inch or less long: heads larger: involucre $\frac{1}{2}$ inch high, very woolly; its linear and attenuate-acuminate bracts squarrose-spreading or the tips recurved: rays violet or purple, $\frac{1}{4}$ to $\frac{1}{2}$ inch long. —

Rocky Mountains, in or near the alpine region, from British Columbia to Colorado.

Var. **elatior**, Gray. A foot or two high, *leafy up to the 1 to 4 pedunculate heads*, pubescent, but hardly hirsute: leaves oblong to ovate-lanceolate, 2 to 4 inches long; cauline closely sessile by a broad base: involucre fully $\frac{1}{2}$ inch high: rays $\frac{1}{2}$ inch long. — Am. Jour. Sci. II. xxxiii. 237. Subalpine and lower, in the mountains of Colorado.

* * *Perennials from a rootstock or caudex, neither stoloniferous nor flagelliferous: involucre from hispid or villous to glabrous, but not lanate.*

+ *Comparatively tall and large (a foot or more high), leafy-stemmed, glabrous to soft-hirsute: leaves rather large, entire or occasionally toothed: heads rather large, with numerous rays: mountain forms.*

++ *Rays 50 to 70, comparatively broad: involucre rather loose: heads solitary or on larger plants few and corymbosely disposed: pappus simple.*

4. **E. salsuginosus**, Gray. Stem 12 to 20 inches high, the summit or peduncles more or less pubescent: no bristly or hirsute hairs: leaves very smooth and glabrous, bright green, thickish; radical and lower cauline spatulate to nearly obovate, with base attenuate into a margined petiole; upper cauline ovate-oblong to lanceolate, sessile, conspicuously mucronate; uppermost small and bract-like: bracts of the involucre loose or even spreading, linear-subulate or attenuate, viscidulous, at most puberulous: disk over $\frac{1}{2}$ inch in diameter: rays purple or violet, $\frac{1}{2}$ inch or more long. — Proc. Am. Acad. xvi. 93. Alpine, from New Mexico and California to the far north.

Var. **glacialis**, Gray. A span high, few-leaved, monocephalous: leaves smaller. — Synopt. Fl. i. Pt. 2. 209. Alpine region of the Rocky Mountains.

5. **E. Coulteri**, Porter. Stem 6 to 20 inches high, equally leafy, bearing solitary or rarely 2 or 3 slender-pedunculate heads: leaves membranaceous, obovate to oblong, either entire or serrate with several sharp teeth, pilose-pubescent to glabrous, cauline hardly mucronate: disk about $\frac{1}{2}$ inch wide: involucre less attenuate and spreading, obscurely viscidulous but hirsute with spreading hairs: rays rather narrowly linear, $\frac{1}{2}$ inch or more long, white, varying to purplish. — Fl. Colorado, 61. Mountains of Colorado, Utah, and California.

++ ++ *Rays 100 or more and narrow: involucre closer: pappus more or less double, but the exterior minute: stems erect, tufted, generally leafy to the summit and bearing few to several heads: leaves entire: mountain forms but not alpine.*

6. **E. macranthus**, Nutt. From hirsute-pubescent to nearly glabrous, more leafy than the next: stem 10 to 20 inches high: leaves from lanceolate to ovate; upper often reduced in size: involucre glabrous or nearly so, but commonly minutely glandular: rays $\frac{1}{2}$ inch long: short outer pappus sometimes nearly chaffy. — Mountains from Wyoming to New Mexico and Utah.

7. **E. glabellus**, Nutt. From partly glabrous to copiously hirsute, disposed to be naked above: stems 6 to 20 inches high: leaves lanceolate or the lowest somewhat spatulate; upper linear-lanceolate and gradually reduced to subulate bracts: heads considerably smaller: involucre strigosely hirsute or pubescent: rays violet, purple, and rarely white, $\frac{1}{2}$ to $\frac{1}{2}$ inch long: outer pappus setulose. — From Colorado and Utah northward and eastward.

Var. mollis, Gray. Somewhat cinereous with a soft and short spreading pubescence, a foot or two high, leafy to the top: leaves oblong-lanceolate: cinereous pubescence of the involucre soft and spreading. — Proc. Acad. Philad 1863, 64. Mountains of Colorado

+ + *Low, rarely a foot high, conspicuously hispid or hirsute with spreading bristly hairs: leaves entire, narrow: involucre close: rays numerous, occasionally wanting: pappus conspicuously double.*

+ + *Sparingly branched stems from the crown of a tap-root, more or less leafy: heads middle-sized: disk $\frac{1}{3}$ to $\frac{1}{2}$ inch in diameter: involucre hispid: rays 50 to 80, occasionally wanting in the second species.*

8. **E. pumilus**, Nutt. Radical and lower cauline leaves from spatulate-linear to lanceolate, a line or two wide; upper linear: rays white, 4 lines long: outer pappus of short bristles little or not at all thicker than the inner ones and more or less intermixed with them. — Dry plains, the Dakotas to Colorado, and in the mountains to Utah.

9. **E. concinnus**, Torr. & Gray. Like the preceding, but usually with more dense and shaggy hirsuteness and less rigid leaves: stems not rarely somewhat copiously branched: rays violet or blue, rarely white: outer pappus conspicuous and chaffy. — Fl. ii. 174. In arid regions from New Mexico and Arizona to Wyoming and British Columbia.

Var. aphanactis, Gray. Discoid, the rays being nearly destitute of ligule or wanting. — Proc. Am. Acad. vi. 540. — Colorado to Nevada and California.

+ + *More branched and leafy, over a span high; with smaller heads, fewer rays, and somewhat naked involucre more imbricated.*

10. **E. Brandegei**, Gray. A very imperfectly known plant, green, sparsely hispidulous-hirsute: radical leaves spatulate-linear; cauline linear and small, or upper minute: bracts of involucre short-linear, almost naked: rays 30 or more, white: outer pappus of coriaceous chaffy scales, which are commonly confluent with the scanty bristles of the inner. — Synopt. Fl. i. Pt. 2. 210. Adobe plains, S. W. Colorado, on the borders of New Mexico, Brandegee.

+ + + *Dwarf, caespitose from a multicapital caudex, with monocephalous flowering stems: radical leaves dissected: pappus simple.*

11. **E. compositus**, Pursh. From hirsute to glabrate, with slender margined petiole setose-ciliate: radical leaves much crowded on the crowns of the caudex, usually 1 to 3-ternately parted into linear or short and narrow spatulate lobes, the few on the erect flowering stems 3-lobed or entire and linear: involucre 3 or 4 lines high, sparsely hirsute: rays from 40 to 60, not very narrow, white, purple, or violet, mostly 3 or 4 lines long. — Alpine regions, from S. Colorado and California to British Columbia and northward.

Var. discoideus, Gray. Rays wanting or abortive: head commonly smaller. — Am. Jour. Sci. ii. xxxiii. 237. — Same range as the type.

Var. trifidus, Gray. Small blade of leaves simply 3 to 5-fid: the lobes from oblong to obovate. — Proc. Am. Acad. xvi. 90. *E. trifidus*, Hook. Mountains, N. Colorado to British Columbia.

Var. pinnatisectus, Gray. Usually a large form: numerous violet-purple rays 5 lines long: leaves pinnately parted into 9 to 11 linear and entire or rarely 2 to 3-cleft divisions. — Loc. cit. Mountains of Colorado.

+ + + + Dwarf or low species, alpine, entire-leaved, cespitose from a multicapital caudex, no fine pubescence, monocephalous: leaves few on the simple stems, at least the radical broader than linear: rays numerous and not very narrow: pappus simple or nearly so.

++ Involucre glabrous but pruinose-glandular, brownish purple: smooth and green.

12. **E. leiomerus**, Gray. A span high, smooth and very glabrous: leaves bright green, mainly radical and spatulate, very obtuse, from 2 to 6 lines wide; cauline only 2 or 3 and smaller: involucre 3 lines high, close; the bracts lanceolate and not attenuate: rays about 40, linear, violet, 3 or 4 lines long. — Synopt. Fl. i. 211. *Aster glacialis* in Bot. King Exp. Mountains of Colorado, Utah, and Nevada.

++ ++ Involucre hirsute or pubescent, greenish.

13. **E. ursinus**, Eaton. A span or two high, loosely cespitose: leaves duller green, mostly smooth and glabrous, but their margins more or less hirsute-ciliate, spatulate to narrowly oblanceolate; cauline ones lanceolate or linear and acute: involucre (3 lines high) and naked summit of flowering stem hirsute-pubescent: rays 40 or 50, purple, narrowly linear, 3 lines long. — Bot. King Exp. 148. Alpine and subalpine, mountains of Wyoming to S. Colorado, Utah, and California.

14. **E. radicans**, Hook. A span high or less, densely tufted: leaves all spatulate-linear or somewhat wider, broadest a line or two wide, hirsute or hirsutely ciliate, or sometimes almost naked, then glabrous; no glandular roughness: involucre more or less villous-pubescent, barely 3 lines high: rays white or purple, 2 or 3 lines long. — Alpine or subalpine, from British America to Wyoming, S. Colorado, and Utah.

15. **E. glandulosus**, Porter. Cespitose from a stout caudex, a span to a foot high, rigid, granulose-glandular or glandular-scabrous, and with sparse or hispid hairs, especially on the margins of the leaves: leaves thickish, spatulate to linear-oblanceolate, 1 to 3 inches long: head 4 or 5 lines high: involucre glandular or viscid as well as pubescent: rays 40 or 50, violet or purple, 4 to 6 lines long. — Fl. Colorado, 60. Mountains of Colorado.

+ + + + None truly alpine; with entire leaves, not hispidly hirsute: involucre close, disposed to be imbricated and rigid: rays not very numerous or wanting.

++ A span or two high: leaves only few and narrow on the simple or sparingly branched stems; but radical ones with obovate or spatulate blade $\frac{1}{2}$ inch long: rays 18 to 30, pale violet or purple: akenes compressed, 2 to 3-nerved: pappus nearly simple.

16. **E. tener**, Gray. Canescent with very fine pubescence: stems several from a caudex, weak and ascending, bearing single or 2 or 3 heads: involucre minutely canescent; its narrow and close bracts unequal, somewhat in 2 or 3 ranks: rays 25 to 30. — Proc. Am. Acad. xvi. 91. High mountains of Utah and California to those of Wind River, Montana.

++ ++ A span to near a foot high, cespitose, silvery-canescant, with simple and monocephalous stems: leaves from narrowly spatulate to linear: rays 40 or

50, white or purple changing to white: akenes slender and nearly terete, 8 to 10-nerved or striate: pappus double; the outer subulate and conspicuous.

17. **E. canus**, Gray. Silvery appressed pubescence obviously strigulose under a lens, that of the involucre loose and spreading: stems 4 to 9 inches high, leafy: linear cauline leaves gradually diminishing upward; radical spatulate-lanceolate or narrower: head 4 lines high: rays narrow, 3 lines long: akenes glabrous. — Pl. Fendl. 67. N. New Mexico and Colorado; also on the Platte in Wyoming.

++ ++ ++ *Either low or comparatively tall, leafy-stemmed or somewhat scape-like: akenes compressed, 2 or 3-nerved.*

= *Leaves all narrowly linear to filiform, the broadest not over a line wide: involucre 3 or 4 lines high, of equal bracts.*

18. **E. ochroleucus**, Nutt. Low, a span or two high, somewhat caespitose, from pubescent to glabrate: stems usually simple, naked above and mostly monocephalous: leaves rather rigid, the radical 2 or 3 inches long: involucre hirsute-pubescent: rays 40 to 60, "ochroleucous," white or purplish: outer pappus setulose. — Gravelly soil, N. Wyoming and Montana to Idaho.

= = *Leaves from narrowly linear to oblong.*

a. *Stems naked above, mostly simple and monocephalous, a span or two high: pappus simple.*

19. **E. Eatoni**, Gray. Stems several from the crown of a strong tap root, slender and weak, diffuse, 3 to 9 inches long, simple or with 2 or 3 monocephalous branches: leaves all linear, thickish, minutely pubescent; radical about 2 inches long and the broadest 2 lines wide: heads only 3 lines high: bracts of the sparsely hirsute involucre little unequal: rays seldom over 20, at most 3 lines long, white or purplish. — Proc. Am. Acad. xvi. 91. *E. ochroleucus*, Eaton, Bot. King Exp. 152. Mountains of Colorado, Wyoming, and Utah.

b. *Stems more leafy and disposed to branch, but sometimes monocephalous: pubescence cinereous: outer pappus setulose, sometimes obscure or none.*

20. **E. cæspitosus**, Nutt. Low, a span to rarely a foot high, many-stemmed and ascending or spreading from a stout caudex, from cinereous to canescent with dense and fine short pubescence: stems of smaller plants monocephalous: radical leaves spatulate to lanceolate, and cauline lanceolate-oblong to linear, $\frac{1}{2}$ to 2 inches long: heads short-peduncled, 3 or 4 lines high: bracts of the involucre rather unequal: rays 40 or 50, linear, 3 or 4 lines long, white, sometimes tinged with rose-color. — From the Saskatchewan to New Mexico and westward.

21. **E. corymbosus**, Nutt. Taller, often a foot or two high, erect from creeping rootstocks, soft-cinereous with mostly spreading short pubescence: radical leaves narrow-lanceolate or spatulate-lanceolate, largest 3 or 4 inches long and 3 or 4 lines wide, 3-nerved: cauline linear and narrow: heads sometimes solitary, usually several and corymbosely disposed on short slender peduncles: involucre 3 lines high, canescently pubescent: rays 30 to 50, mostly narrow and 3 to 5 lines long, blue or violet, apparently sometimes white. — Mountains of Montana to those of Washington and California.

c. Stem leafy, most branched above and bearing few or several heads: pubescence not cinereous nor spreading, either strigose or none: pappus simple.

22. *E. decumbens*, Nutt. Stem or culm simple, erect or spreading 6 to 18 inches high, at the base branched or pubescent or glaucous: leaves linear or sometimes linear-spatulate (base of the petiole) 4 to 6 inches long and only a line or two wide: the lower usually striate or pubescent: rays 15 to 40, white, purplish, or violet-tinted. — Mountains from Mexico and Utah to Oregon and California.

*** Perennial by stoloniform creeping rootstocks, or creeping leafy stems or stolons: rays very numerous (100 or more) and narrow: low ground forms.

23. *E. Philadelphicus*, L. Stem simple, a foot or two high, spreading by rotulate offsets borne on apex of stoloniform creeping rootstocks: stem striate-angled, erect, very rarely branching and bearing several small leaves: leaves oblong, or linear-spatulate, upper ones linear, lower ones oblong, sparingly and coarsely serrate or entire: peduncles thickened under the head: rays pink, almost filiform: pappus simple. — Across the continent.

24. *E. flagellaris*, Gray. More or less cinereous with appressed pubescence: stems slender, diffusely decumbent and flagelliform but leafy, some prostrate, many at length rooting at the apex and polyferous: leaves small, entire; radical spatulate and petioled; those of the branches becoming linear: solitary peduncles 2 to 5 inches long: rays white or purplish: pappus double. — Pl. Fendl. 69. From the Upper Platte to Colorado, New Mexico, and W. Texas.

**** Mostly cinereous-pubescent or strigose annuals, leafy-stemmed and very branching, often diffusely: heads conspicuously radiate and mostly paniculate: low grounds and plains.

+ Akenes narrow, little compressed, with a broad and whitish truncate apex and a simple capillary pappus: rays 40 to 70: leaves always entire.

25. *E. Bellidiastrum*, Nutt. Diffusely or loosely branched a spat or two high, sterile, apical or terminal: leaves spatulate-lanceolate or linear-lanceolate, an inch or less long: lower peduncles branched: rays light purple. — Nebraska to New Mexico.

+ + Akenes compressed, 2-nerved: pappus double: inner often fragile or deciduous: rays mostly more numerous: leaves sometimes toothed or lobed.

26. *E. divergens*, Torr. & Gray. Diffusely branched and spreading, a foot or less high, cinereous-pubescent or hirsute: leaves linear-spatulate or the upper linear and lowest narrower and sometimes narrower toward the base: heads 2 or 3 lines high: rays white or purplish, very numerous: involucre hirsute: inner pappus of rather scanty bristles: outer of short subulate scales. — Fl. ii. 175. From Nebraska to W. Texas and westward to the coast.

27. *E. strigosus*, Moench. Diffusely or loosely branched, a foot or less high, erect, seldom over 2 feet high, rarely branched above: leaves linear-lanceolate or oblong, often serrate: rays mostly white, not excessively numerous nor very narrow: involucre with few or no bristly hairs: outer pappus a short crown of distinct or partly united slender scales, persistent after the fragile inner pappus is shed. — From Nebraska to New Mexico and Texas and westward to Oregon and California.

Var. **Beyrichii**, Gray. A slender form, with minute or even cinereous pubescence, smaller heads, and rays from white to pale rose-color. — Synopt. Fl. i. 219. Within the eastern limits of our range.

§ 2. *Rays inconspicuous or slender, numerous, sometimes not exceeding the disk: within them a series of rayless filiform female flowers (commonly none in No. 29): leaves entire or nearly so: pappus simple.* — TRIMORPHÆA.

28. **E. acris**, L. More or less hirsute pubescent, varying towards glabrous (not glandular): cauline leaves mostly lanceolate, the lower and radical spatulate: involucre hirsute: rays slender, equalling or moderately surpassing the disk and pappus, purple: filiform female flowers numerous. — In the mountains of Colorado and northward to British Columbia, thence across the continent.

Var. **Drebachensis**, Blytt. Somewhat glabrous, or even quite so: involucre also green, naked, at most hirsute only at the base, often minutely viscidulous: slender rays somewhat slightly exserted, sometimes minute and filiform and shorter than the pappus. — Same range as the type.

Var. **debilis**, Gray. Sparsely pilose: stems a span to a foot high, slender, 1 to 3-cephalous: leaves bright green; radical obovate or oblong; cauline spatulate to lanceolate, short: involucre sparsely hirsute or upper part glabrate, the attenuate tips of the bracts spreading: rays in flower rather conspicuously surpassing the disk. — Synopt. Fl. i. 220. Mountains of N. Montana, northward and eastward.

29. **E. armeriæfolius**, Turcz. Sparsely hispid-hirsute or the leaves glabrous and most of the narrowly linear and elongated cauline bristly-ciliate: inflorescence more racemose and strict: involucre sparsely hirsute: rays filiform, extremely numerous, slightly surpassing the disk, whitish, no filiform rayless flowers seen. — From the mountains of California and Colorado to the Saskatchewan.

§ 3. *Rays of the small (2 lines high) and narrow seemingly discoid (and mostly thyrsoid-paniculate) heads inconspicuous, little if at all surpassing the disk or pappus: leaves more or less hispid-ciliate.* — CENOTUS, in part.

30. **E. Canadensis**, L. From sparsely hispid to almost glabrous: stem strict, 1 to 4 feet high, with numerous narrowly paniculate heads, or in depauperate plants only a few inches high and with few scattered heads: leaves linear, entire, or the lowest spatulate and incised or few-toothed: rays white, usually a little exserted and surpassing the style-branches. — Waste grounds, throughout the continent.

31. **E. divaricatus**, Michx. Low, a span to a foot high, diffusely much branched, somewhat fastigiate: leaves all narrowly linear or subulate, entire: rays purplish, rarely surpassing the style-branches of the pappus. — Fl. ii. 123. Open grounds from Colorado to the Mississippi Valley.

15. CONYZA, Less.

1. **C. Coulteri**, Gray. A foot or two high, commonly branched, bearing numerous small heads in a mostly crowded thyrsoid leafy panicle, viscidly pubescent or partly hirsute: cauline leaves linear-oblong, the lower spatulate-oblong and with partly clasping base, from dentate to lacinate-pinnatifid, an

inch or two long : involucre 1 or 2 lines high, hirsute with rather soft spreading hairs, considerably shorter than the soft pappus : flowers whitish. — Proc. Am. Acad. vii. 355. W. Texas and Colorado to Arizona and California.

16. BACCHARIS, L.

More or less shrubby : with alternate simple leaves, and the branches striate, bearing small heads of white or yellowish flowers.

1. **B. Wrightii**, Gray. *Herbaceous from a woody base, very smooth and glabrous, a foot or two high, diffusely branching, sparsely leaved : slender branches terminated by solitary heads : leaves linear, small ; uppermost linear-subulate : involucre campanulate, 4 or 5 lines high ; its bracts lanceolate, gradually acuminate, conspicuously scarious-margined, with a green back : pappus very copious and pluriserial, soft, elongating in fruit, fulvous or purplish, four times the length of the scarious-glandular 8 to 10-nerved akene.* — Pl. Wright. i. 101. W. Texas to S. Colorado and Arizona.

2. **B. salicina**, Torr. & Gray. *Branching shrubs, 3 to 12 feet high, glabrous or nearly so, usually viscous, with a resinous exudation : leaves mostly subsessile, from oblong to linear-lanceolate, sparingly toothed, rarely entire : heads or glomerules pedunculate : involucre campanulate, about 3 lines high ; its bracts ovate and acutish : pappus more or less copious, but mostly uniserial, conspicuously elongating in fruit, white, soft and flaccid : akenes 10-nerved.* — Fl. ii. 258. Colorado to Texas.

3. **B. glutinosa**, Pers. *Stems herbaceous above but woody toward the base, 3 to 10 feet high : branches somewhat striate-angled : leaves elongated-lanceolate, serrate with few or several scattered teeth on each side, more or less distinctly 3-nerved from near the base, 3 or 4 and the larger 5 or 6 inches long : heads mostly 3 lines long, numerous and corymbosely cymose at the summit of comparatively simple stems or branches : involucre stramineous : pappus not very copious, nor flaccid, and elongated hardly at all in fruit : akene 5-nerved.* — From S. California to S. Colorado and Texas.

17. EVAX, Gærtn.

Dwarf and depressed annuals, floccose-woolly. In ours the heads are small and aggregated in terminal foliose-involucrate glomerules.

1. **E. prolifera**, Nutt. Rather stout : stem often a span high, simple and erect, or with ascending branches from the base, bearing numerous small spatulate leaves and a capituliform glomerule, half an inch in diameter ; whence proceed 1 to 3 nearly leafless branches similarly terminated, sometimes again proliferous : fructiferous bracts scarious, oval or oblong, mainly naked ; those embracing staminate flowers more herbaceous and woolly-tipped, of firmer or more herbaceous texture : staminate flowers each on a filiform stipe representing an abortive ovary. — *Diaperia prolifera*, Nutt. Dry ground, Colorado to the Dakotas and Texas.

18. ANTENNARIA, Gærtn. EVERLASTING.

Mostly low, canescently and often floccosely woolly herbs, with whitish or purplish flowers : bracts of the involucre pearly white, rose-color, or brownish, never yellow.

§ 1. *Bristles of the male pappus hardly at all thickened but minutely barbellate near the apex: akenes puberulent: bracts of the involucre brownish.*

1. **A. dimorpha**, Torr. & Gray. Depressed, caespitose from a stout multicapital caudex, bearing rosulate clusters of spatulate leaves: heads solitary and subsessile at the crown, or raised on a sparsely-leaved stem of an inch or less in height: male head 4 lines high, with broad and obtuse involucral bracts; female becoming $\frac{1}{2}$ to $\frac{3}{4}$ inch long, the inner bracts narrow and long-attenuate into a hyaline acuminate tip: pappus of the fertile flowers of long and fine smooth bristles. — Fl. ii. 431. Dry hills, from Wyoming to California and British Columbia.

§ 2. *Bristles of the male pappus stouter, with thickish and clavate or scarious-dilated tips.*

* *Not surculose-stoloniferous: stems simple from the subterranean branching caudex, leafy, naked at summit, and bearing a cluster of broad heads: inner bracts of the male involucre all with conspicuous ivory-white papery obtuse tips; those of the female with hardly any tips and more scarious: herbage silvery-lanate.*

2. **A. luzuloides**, Torr. & Gray. *Closely silky-woolly: stems slender, a span to a foot high: leaves all narrowly linear, or some of the lowest narrowly lanceolate-spatulate, small uppermost linear subulate: heads small (2 lines, or the female barely 3 lines long), several or numerous: involucre glabrous marly or quite to the base; the inner bracts in the female heads obtuse: akenes glandular: the spatulate and as it were petaloid tips of the male pappus obtuse.* — Fl. ii. 430. From Wyoming to Oregon and British Columbia.

3. **A. Carpathica**, R. Br. *Floccosely white-woolly, rather stout: lower leaves spatulate-lanceolate and the upper linear: heads broad, 3 or 4 lines long: involucre conspicuously woolly at base, more or less livid, except the white tips to the bracts of the male; the inner bracts of the female commonly acutish and thin-scarious: akenes smooth and glabrous.* — In the Northern Rocky Mountains, and extending south to Oregon; represented in the lower Rocky Mountains as far south as New Mexico, by the

Var. **pulcherrima**, Hook. Stems 6 to 18 inches high: leaves mostly larger, the radical often half an inch or even almost an inch wide: heads more numerous, often in a compound cyme: bristles of the male pappus with more strongly and abruptly or even scariously dilated tips.

* * *Surculose-proliferous by either subterranean or leafy shoots or stolons.*

+ *Heads in a cymose cluster, sometimes solitary: involucre woolly at base.*

4. **A. alpina**, Gærtn. Somewhat caespitose: *radical shoots few and short: flowering stems 1 to 4 inches high, bearing 2 to 5 heads, sometimes a single head: radical leaves spatulate, $\frac{1}{2}$ inch long: involucre 3 lines high, livid-brownish; the inner of the male heads with whitish oblong tips, of the female wholly livid and scarious and from acutish to acuminate: akenes glandular.* — High mountains of Colorado and California, and far northward.

5. **A. dioica**, Gærtn. *Freely surculose and forming broad mats: flowering stems 2 to 8 or even 12 inches high, bearing few or numerous heads: radical leaves from obovate to spatulate, half-inch to nearly an inch long, rarely glabrate above: bracts of the involucre in both sexes with colored (white or rose-colored)*

and obtuse papery tips: akenes smooth and glabrous or sometimes minutely glandular. — Throughout the mountain region at all elevations and northward, thence eastward across the continent.

Var. **congesta**, DC., has heads sessile in a rosulate tuft of leaves terminating depressed stems, like the sterile creeping ones. — Alpine on Sierra Blanca, S. Colorado, and similar but taller forms from the mountains of Wyoming, etc.

6. **A. plantaginifolia**, Hook. Freely surculose by *long and slender sparsely leafy stolons*: flowering stems more scapiform, 6 to 18 inches high, bearing small linear or lanceolate leaves and a cluster of several heads: *radical leaves from roundish ovate to obovate and spatulate*, the larger an inch or two long, soon glabrate and green above, silvery-canescens beneath with a completely pannose coating, 3 to 5-nerved: *involucre very woolly at base*; inner bracts of the male heads with oval or oblong obtuse *ivory-white tips*, of the larger (4 to 6 lines long) female heads with *white or whitish* narrow and acute tips: akenes minutely glandular. — From New Mexico to Washington and eastward across the continent.

+ + Heads loosely paniculate: involucre almost glabrous.

7. **A. racemosa**, Hook. Stoloniferous as in the last, lightly woolly, becoming glabrate: flowering stems 6 to 20 inches high, slender, sparsely leafy, bearing few or numerous racemosely or paniculately disposed heads: leaves thin; the radical broadly oval, an inch or two long; lower cauline oblong; upper small and lanceolate: involucre scarious, brownish; the male 2 or 3 lines long, of obtuse bracts, the inner white-tipped; female 3 or 4 lines long, of narrow and mostly acute bracts: akenes glabrous. — From the mountains of Wyoming to the Cascades and the British border.

19. ANAPHALIS, DC. EVERLASTING.

1. **A. margaritacea**, Benth. & Hook. Commonly a foot or two high, in tufts, very leafy, the white floccose wool rarely becoming tawny: leaves 2 to 5 inches long, from rather broadly to linear-lanceolate, soon glabrate and green above, the broader ones indistinctly 3-nerved: heads numerous, cymbosely cymose: bracts of the involucre very numerous, almost wholly pearly white, radiating in age. — *Antennaria margaritacea*, R. Br. Higher mountains of Colorado and California and far northward; across the continent in its cooler portions.

20. GNAPHALIUM, L. CUDWEED. EVERLASTING.

Floccose woolly herbs: with sessile and sometimes decurrent entire leaves, and cymosely clustered or glomerate heads of whitish or yellowish flowers. Ours belong to the section in which the bristles of the pappus are not united, but fall separately.

* *Involucre woolly only at base, the scarious bracts from white to brownish straw-color: more or less fragrant herbs, erect, a foot or two high: akenes smooth and glabrous.*

1. **G. Sprengelii**, Hook. & Arn. Stems usually stout, 6 to 30 inches high: leaves lanceolate or linear, or the lowest spatulate, *densely white-woolly*,

or sometimes thinly floccose, the *short decurrent bases* or adnate auricles rather broad, *slightly if at all glandular or heavy-scented*: heads in single or few close glomerules terminating the stem or branches: involucre hemispherical, white or yellowish, becoming rusty-tinged. — *G. luteo-album*, var. *Sprengelii*, Eaton. From Texas and Colorado to S. California and N. Oregon.

2. *G. decurrens*, Ives. Stem stout, 2 or 3 feet high, corymbosely branched above and bearing *cymosely crowded glomerules* of broad heads: leaves very numerous, lanceolate or the upper linear, *obviously adnate-decurrent*, the upper face becoming naked and green in age and with the stem *glandular-pubescent or viscid*, white-woolly beneath, *strongly balsamic-scented*: involucre campanulate, white, becoming rusty-tinged. — Am. Jour. Sci. i. 380. From Texas and New Mexico to Washington and British Columbia, and eastward to New England.

* * *Involucre less imbricated, more involved in wool, the scarious tips of the nearly equal bracts inconspicuous and dull-colored*: heads *glomerate and leafy-bracteate*, only a line or so in length: low and branching annuals, a few inches or rarely a foot high: akenes either smooth or scabrous.

3. *G. palustre*, Nutt. *Loosely floccose with long wool*, erect, at length diffuse or weak: leaves 3 to 5 lines wide, spatulate or the uppermost oblong or lanceolate: tips of the linear involucre bracts white, obtuse. — In moist grounds from New Mexico to Wyoming and westward.

4. *G. strictum*, Gray. *Appressed-woolly*: stem strict and simple, a span to a foot high, sometimes branching or with ascending stems from the base: leaves all linear, seldom a line wide: heads in *spicately disposed glomerules* in the axils or on short lateral branches: involucre bracts with *brownish or somewhat whitish tips*, obtuse. — Pacif. R. Rep. iv. 110. Rocky Mountain region, from Wyoming to New Mexico and Arizona.

21. MELAMPODIUM, L.

Branching herbs, with opposite mostly sessile leaves, and pedunculate heads terminating the branches or in the forks. In our species the rays are conspicuously exserted and white, and the fructiferous bracts hooded.

1. *M. cinereum*, DC. Branched from the base, a span to a foot high, cinereous or even silvery-canescens with a close pubescence, or greener: leaves linear or the lower lanceolate or spatulate, entire or undulate, or even sinuate-pinnatifid: ligules 5 to 9, cuneate-oblong, 2 to 3-lobed at apex, 3 to 6 lines long: bracts of the involucre ovate, appressed, slightly united at base: fructiferous bracts nearly terete, somewhat incurved, muricate with sharp tubercles; its hood about the length of the body and very much wider, nearly smooth, its truncate and usually even margin commonly incurved. — From S. and E. Colorado to Arizona, Texas, and W. Arkansas.

22. SILPHIUM, L. ROSIN-WEED.

Tall and coarse perennials: with resinous juice, large leaves, and ample pedunculate heads of yellow flowers. Our species is the "Compass-Plant," with alternate deeply pinnatifid or bipinnatifid leaves, and large heads (sessile or nearly so) racemously disposed along the naked summit, and very rough herbage.

1. **S. laciniatum**, L. Stem 3 to 6 and even 12 feet high: radical leaves a foot or two long, long-petioled, once or twice pinnately parted or below divided, the divisions and lobes lanceolate to linear; cauline with petiole simply dilated at base, or with stipuliform and sometimes palmatifid appendages; upper sessile and reduced to bracts: involucre inch or more high and broad: rays numerous, inch or two long, bright yellow. — Prairies, from the Dakotas to Texas and eastward to Wisconsin and Alabama.

23. PARTHENIUM, L.

Ours is an acaulescent caespitose perennial, with the ligule wanting.

1. **P. alpinum**, Torr. & Gray. Densely tufted on a thick branching caudex, depressed, rising only 1 or 2 inches: leaves crowded, silvery-canescant with a fine appressed pubescence, and villous in the axils, spatulate-linear, barely an inch long, entire: heads solitary and nearly sessile among the leaves: pappus a pair of oblong-lanceolate membranaceous scales. — Mountains of Wyoming.

24. PARTHENICE, Gray.

Allied to both *Parthenium* and *Iva*.

1. **P. mollis**, Gray. Annual, with odor of *Artemisia*, 4 to 6 feet high, paniculately branched, minutely cinereous throughout, wholly destitute of any coarser pubescence: leaves all alternate, ovate, some of the larger (10 or 12 inches long) subcordate, acuminate, irregularly or doubly dentate, long-petioled: heads small, 2 lines broad, numerous in loose axillary and terminal somewhat leafy panicles: flowers greenish-white. — S. Colorado to Arizona.

25. IVA, L.

Herbs or shrubs. with entire or serrate leaves, at least the lower ones opposite, and small spicately or racemously or paniculately disposed or scattered and commonly nodding heads.

* *Heads crowded in narrow spike-like clusters which are aggregated in a naked panicle: leaves long-petioled.*

1. **I. xanthiifolia**, Nutt. Tall and coarse, 3 to 5 feet high, pubescent, at least when young: leaves mainly opposite, broadly ovate, ample, coarsely or incisely serrate, acuminate, 3-ribbed at base, puberulently scabrous above: panicles axillary and terminal: outer involucral bracts 5, broadly ovate and herbaceous; inner of as many membranaceous dilated-obovate or truncate ones, which are strongly concave at maturity and half embrace the obovate-pyriform and glabrate akenes. — From New Mexico to Idaho and the Saskatchewan.

* * *Heads spicately or racemously disposed in the axils of leaves or foliaceous bracts, and nodding.*

2. **I. ciliata**, Willd. Rather stout, 2 to 6 feet high, strigose and hispid: leaves nearly all opposite, ovate, acuminate, sparsely serrate, the base abruptly contracted into a hispid petiole: spikes strict, 3 to 8 inches long; their bracts lanceolate and ovate-lanceolate, foliaceous, surpassing the at length deflexed heads, hispid-ciliate, as are the 3 or 4 herbaceous and unequal distinct or partly united bracts of the involucre. — From New Mexico to Nebraska and eastward.

3. **I. axillaris**, Pursh. Stems or branches nearly simple, ascending, a foot or two high: leaves from obovate or oblong to nearly linear, obtuse, entire, sessile, rarely over an inch long, even the uppermost usually much surpassing the mostly solitary heads in their axils: bracts of the involucre connate into a 4 or 5-lobed or sometimes parted, or merely crenate cup. — From New Mexico to the Dakotas and the Saskatchewan, and westward.

26. OXYTENIA, Nutt.

Shrubby species, with *Artemisia*-like habit.

1. **O. acerosa**, Nutt. Shrubby, but soft-woody, 3 to 5 feet high, canescent, with erect branches sometimes leafless and rush-like: leaves when present alternate, pinnately 3 to 5-parted into long filiform divisions, or uppermost entire: heads numerous, 2 lines long, in dense panicles. — Dry plains, S. W. Colorado to S. E. California.

27. DICORIA, Torr. & Gray.

1. **D. Brandegei**, Gray. Strigulose-canescens, diffusely and alternately branched: leaves of the branches oblong-lanceolate or partly spatulate, obtuse, mostly entire, an inch or less long and with slender petiole: heads sparse, racemose-paniculate: fertile flower solitary, its dilated-cuneate hyaline subtending bract hardly surpassing the outer involucre: akene naked and exserted, bordered with pectinate callous teeth connected by an indistinct scarious margin. — Proc. Am. Acad. xi. 76. Sandy bottoms of the San Juan, near the boundary between Colorado and Utah.

28. AMBROSIA, Tourne. RAGWEED.

Coarse herbs, with mostly lobed or dissected opposite and alternate leaves, and dull inconspicuous flowers: sterile heads racemose or spicate and with no bracts: fertile flowers usually glomerate in axils below.

* *Involucre of sterile heads 3-ribbed: no chaff on the receptacle: leaves palmately cleft, ample, petioled.*

1. **A. trifida**, L. Tall and stout, 3 to 12 feet high or more, roughish hispid or almost glabrous: leaves all opposite, very deeply 3-lobed or the lower 5-lobed; the lobes acuminate, serrate: sterile racemes long and dense: fertile heads clustered and as if involucre by short bracts: fruit very thick, with 5 to 7 strong ribs or angles terminating above in spinous tubercles around the base of the conical beak. — From the plains of Colorado eastward across the continent.

* * *Involucre of sterile heads not ribbed: receptacle with some chaff: leaves mostly 1 to 3-pinnatifid or dissected.*

2. **A. artemisiæfolia**, L. Various pubescent or hirsute, paniculately branched, a foot or two high, or taller: leaves thin, bipinnatifid or pinnately parted with the divisions irregularly pinnatifid or sometimes nearly entire, on the flowering branches often undivided: sterile heads pedicelled: fruit short-beaked, armed with 4 to 6 short acute teeth or spines. — A weed in waste and

cultivated grounds across the continent, known variously as "Roman Worm-wood," "Ragweed," and "Bitter-weed."

3. **A. psilostachya**, DC. From slender running rootstocks, *stouter*, 2 to 6 feet high, with strigose and some loose hirsute pubescence: *leaves thickish; upper simply and lower twice pinnatifid; the lobes mostly lanceolate and acute*: sterile heads commonly short-pedicelled: fruit mostly solitary in the axils below, rugose-reticulated, obtusely short-pointed, *either wholly unarmed or with four short either blunt or acute tubercles*. — From the Saskatchewan to Texas and westward across the continent.

29. FRANSERIA, Cav.

Ours are herbaceous, with chiefly alternate leaves, and the spines of the fruiting and 1 to 2-flowered involucre comparatively few.

* *Fruiting involucre seldom over a line long, in the same plant bearing either 1 or 2 flowers.*

1. **F. tenuifolia**, Gray. Erect, 1 to 5 feet high, leafy to the top, hispid, variously pubescent, or glabrate: leaves mostly 2 to 3-pinnately parted or dissected into narrowly oblong or linear lobes, the terminal elongated: sterile racemes commonly elongated and paniculate: fertile heads in numerous glomerules below, in fruit minutely glandular, usually 2-flowered, armed with 6 to 18 short and stout incurving spines, their tips almost always hooked, and an excavated cartilaginously bordered areola above each. — Pl. Fendl. 80. From Colorado to California, Texas, and southward.

* * *Fruiting involucre 3 or 4 lines long at maturity, and longer stout or broad spines: stems low.*

2. **F. Hookeriana**, Nutt. *Diffusely spreading* from an annual root, freely branched, *hirsute-pubescent or hispid*: leaves of ovate or roundish outline, 1 to 3 inches broad, and *bipinnatifid, or the upper oblong and pinnatifid*: sterile racemes solitary or paniculate: fruiting involucre armed with *flat and thin lanceolate-subulate* smooth and glabrous *long and straight spines, 1-flowered*. — From the Saskatchewan to Texas and westward across the continent.

3. **F. discolor**, Nutt. A foot or less high, *erect* from perennial slender creeping root-stocks: *leaves canescently tomentose beneath, green and glabrate above, interruptedly-pinnatifid*, oblong in outline, comparatively large, the lowest often 6 inches long; the lobes usually short and broad: sterile racemes commonly solitary: fruiting involucre *2-flowered, canescent*, armed with rather *short conical-subulate very acute and straight spines*. — Plains, Nebraska to Wyoming, Colorado, and New Mexico.

4. **F. tomentosa**, Gray. A foot high, *rather stout, erect*, from an apparently perennial base, *canescent with a dense sericeous tomentum: leaves very white beneath, cinereous above, pinnately 3 to 5-cleft or parted*; the terminal division large, oblong or broadly lanceolate, serrate; upper lateral similar but smaller; lowest commonly very small and entire: fruiting involucre 3 lines long, *2-flowered, nearly glabrous*; the *short spines conical-subulate, very acute, and the very tip usually uncinately-incurved*. — Pl. Fendl. 80. Along streams or riverbeds, Kansas and E. Colorado.

30. **XANTHIUM**, Tourn. COCKLE-BUR. CLOT-BUR.

Coarse annuals: with branching stems, alternate and usually lobed or toothed leaves, and mostly clustered heads, both sexes in terminal and larger axillary clusters, the male uppermost; the lower axillary clusters of few or solitary female heads.

1. **X. Canadense**, Mill. Stem often punctate with brown spots: leaves cordate or ovate, 3-ribbed from the base, with dentate margins and often incised or lobed, on long petioles: fruiting involucre about an inch long, densely beset with rather long prickles, the two stout beaks at maturity usually hooked or incurved, the surface and base of the prickles more or less hispid. — *X. strumarium*, var. *Canadense*, Torr. & Gray. From Texas to the Saskatchewan and westward.

31. **ZINNIA**, L.

With opposite and mostly entire sessile leaves, single heads terminating the branches, and showy flowers. In ours the leaves are narrow and rigid, connate-sessile and crowded, and the akenes 2 to 4-ristate.

1. **Z. grandiflora**, Nutt. Scabrous: stems or branches a span or more high from a stout woody base: leaves linear, 3-nerved at base: involucre narrow, 4 lines long: ligules 4 or 5, at maturity 5 to 8 lines long, dilated-obovate or roundish, light yellow or sulphur-color, becoming white. — Plains and bluffs, E. Colorado to Texas and Arizona.

32. **HELIOPSIS**, Pers.

With loosely branching stems, veiny and mostly serrate 3-ribbed leaves on naked petioles, and pedunculate showy heads with numerous yellow rays.

1. **H. lævis**, Pers. Smooth and glabrous or nearly so throughout, 3 or 4 feet high: leaves bright green, thinish, oblong-ovate or ovate-lanceolate from a truncate or slightly cuneate-decurrent base, acuminate, coarsely and sharply serrate with numerous teeth, 3 to 5 inches long: heads somewhat corymbose: rays broadly linear, an inch long: akenes wholly glabrous and smooth. — Near Cañon City, Colorado, *Brandegee*; chiefly a form of the Atlantic States.

33. **ECHINACEA**, Mœnch.

Perennial herbs, with rather stout erect stems, undivided leaves, the lower long-petioled, and solitary large heads on long peduncles terminating the stem and few branches. Rays from flesh-color to rose-purple, much elongating with age.

1. **E. angustifolia**, DC. Hispid, a foot or two high, mostly simple: leaves from broadly lanceolate to nearly linear, entire, 3-nerved, all attenuate at base, the lower into slender petioles: bracts of the involucre in only about 2 series. — Within the eastern limit of our range and extending eastward.

34. **RUDBECKIA**, L. CONEFLOWER.

With alternate leaves, either simple or compound, and showy pedunculate heads terminating stem and branches: rays yellow, even sometimes wanting, the disk from fuscous to purplish black.

* *Disk from hemispherical to ovoid, black or dull brown: akenes small, quadrangular, wholly destitute of pappus: leaves undivided: involucre soon reflexed.*

1. **R. hirta**, L. Rather stout, 1 to 3 feet high, rough-hispid and hirsute: leaves from oblong to lanceolate, sparingly serrate or nearly entire, 2 to 5 inches long, the lower narrowed into margined petioles: rays when well developed an inch or two long, golden yellow, sometimes deeper colored toward the base: disk at first nearly black, in age dull brown, becoming ovoid in fruit. — Dry and open ground, from Colorado to the Saskatchewan and eastward across the continent.

* * *Disk from globular to cylindrical, yellowish or brownish: akenes comparatively large, somewhat compressed, with a crown-like pappus: involucre loose and foliaceous but not usually reflexed.*

+ *Rays few or several, inch or two long, drooping, pure yellow: disk dull yellowish: the tip of the chaffy bracts cuneate: pappus a short 4-toothed or nearly entire crown: nearly all the leaves cleft or divided: stems branching.*

2. **R. laciniata**, L. Glabrous and smooth, sometimes minutely scabrous, at least on the margins and upper face of the leaves: stem 2 to 7 feet high, branching above: leaves veiny, broad, incisely and sparsely serrate; radical commonly pinnately 5 to 7-foliate or nearly so, and divisions often laciniately 2 to 3-cleft; lower cauline 3 to 5-parted, upper 3-cleft, and those of the branches few-toothed or entire — Moist ground, from Montana to Arizona and New Mexico, and eastward across the continent.

+ + *Rays wanting: disk brownish: the tip of the chaffy bracts puberulent: receptacle bodkin-shaped: scarious cup-shaped pappus very conspicuous: stems stout, simple.*

3. **R. occidentalis**, Nutt. Nearly glabrous and smooth, or somewhat scabrous-puberulent: leaves undivided, ovate or ovate-lanceolate, acuminate, entire, or irregularly and sparingly dentate, 4 to 8 inches long: upper sessile by a rounded or subcordate base; lower abruptly contracted into a short winged petiole, rarely a pair of obscure lateral lobes: disk in age becoming $1\frac{1}{2}$ inch long, and akenes 2 lines long. — Trans. Am. Phil. Soc. vii. 355. Mountains of Wyoming to Idaho and Oregon.

4. **R. montana**, Gray. Smoother, somewhat glaucous, tall and very stout: leaves 8 to 12 inches long, pinnately parted into 3 to 9 oblong-lanceolate divisions, or the lanceolate uppermost cauline with 2 to 4 narrow lateral lobes: disk cylindraceous or cylindrical, at length often 3 inches long and an inch in diameter. akenes with the deep coroniform pappus 3 or 4 lines long. — Proc. Am. Acad. xvii. 217. Mountains of Colorado.

35. LEPACHYS, Raf.

Herbs, with pinnately parted leaves, and terminal long-peduncled showy heads, the drooping rays yellow or partly brown-purple: truncate inflexed tips of the chaff pubescent: disk yellowish, becoming darker.

1. **L. columnaris**, Torr. & Gray. Scabrous, 1 or 2 feet high, branching from the base: divisions of the cauline leaves 5 to 9, from oblong to narrowly linear, sometimes 2 to 3-cleft: rays commonly an inch or more long, normally

all yellow: disk at length columnar, an inch or more long. — Plains, from the Rocky Mountains to the Saskatchewan and Texas.

Var. **pulcherrima**, Torr. & Gray. A part or even the whole upper face of the ray brown-purple. — From Arizona to Texas and Nebraska.

36. BALSAMORRHIZA, Hook.

Low; with thick, deep and balsamic roots; a tuft of radical leaves mostly on long petioles; and short simple few-leaved flowering stems or naked scapes, bearing large and mostly solitary heads of yellow flowers.

* *Leaves entire or nearly so; the principal ones cordate or with cordate base and long-petioled.*

1. **B. sagittata**, Nutt. Silvery-canescant, and the involucre white-woolly: radical leaves from cordate-oblong to hastate, 4 to 9 inches long, the base 2 to 6 inches wide, on petioles of greater length; the few and inconspicuous cauline from linear to spatulate: scape at length a foot or more high: rays 1 to 2 inches long. — Mountains of Colorado to Montana and British Columbia. Used for food by the Indians.

* * *Leaves neither entire nor cordate, varying from laciniately dentate to bipinnately divided: heads solitary on a naked scape or one bearing a pair of small opposite leaves towards the base.*

2. **B. macrophylla**, Nutt. Green, not at all canescent, glabrate, except the ciliate margins of the leaves, usually minutely glandular-viscidulous: leaves ample, ovate or oblong in outline, a span to a foot long, some with only one or two lobes or coarse teeth, most of them pinnately parted into broadly lanceolate and commonly entire lobes: scapes a foot or two high: bracts of the involucre from narrowly lanceolate to spatulate and foliaceous, an inch or two long, nearly equal, either half or fully the length of the rays. — Trans. Am. Phil. Soc. vii. 350. Rocky and Wasatch Mountains, Wyoming to Utah

3. **B. Hookeri**, Nutt. Canescent with fine sericeous or more tomentose pubescence, but not at all hirsute: scapes and leaves a span to a foot high; the latter lanceolate or elongated-oblong in outline, pinnately or bipinnately parted into lanceolate or linear divisions or lobes, or some of them only pinnatifid or incised: involucre from canescently puberulent to lanate; its bracts from linear to oblong-lanceolate, either unequal and well imbricated or sometimes the outermost foliaceous and enlarged. — Torr. & Gray, Fl. ii. 301. West of our range, but represented by

Var. **incana**, Gray. *Densely white-tomentose: leaves often of broader outline.* — Synopt. Fl. i. 266. **B. incana**, Nutt. Wyoming and Montana to N. California.

37. WYETHIA, Nutt.

Stout and mostly low; with ample undivided pinnately veined alternate leaves (mostly entire), and large heads of mostly yellow flowers.

* *Rays from pale yellow or dull straw-color to white.*

1. **W. helianthoides**, Nutt. A span to a foot and a half high, simple and with a single large head, or rarely 3 or 4, hirsute: leaves from oval to

broadly lanceolate, denticulate or entire, 4 to 8 inches long, mostly narrowed at base into a short margined petiole: heads an inch high: bracts of the involucre narrowly lanceolate, numerous: rays nearly 2 inches long: akenes 4 lines long, either prismatic-quadrangular or flattish, 12 nerved: pappus sometimes minute, chaffy coroniform and cleft into few or several teeth. — Northern Rocky Mountains, in moist valleys, S. W. Montana to E. Oregon.

* * *Rays bright yellow.*

+ *Glabrous and smooth throughout, usually balsamic-viscid: leaves lanceolate to oblong.*

2. **W. amplexicaulis**, Nutt. A foot or two high, robust: leaves mostly lanceolate-oblong, entire or denticulate; radical often a foot or more long; upper cauline partly clasping by a rounded or somewhat narrowed base: heads solitary or several, short peduncled: involucre bracts broadly lanceolate, one or two outer ones occasionally foliaceous and larger: rays $1\frac{1}{2}$ inches long: akenes with a conspicuous crown cleft into acute teeth, and sometimes a small awn. — From Colorado to Montana and British Columbia. Called "Pe-ik" by the Indians.

+ + *Hirsutely pubescent or scabrous: leaves elongated-lanceolate or linear.*

3. **W. Arizona**, Gray. *Hirsutely pubescent*, a foot high, bearing a single or few heads: *leaves oblong-lanceolate*, tapering to both ends, or the upper and sessile cauline broader: involucre of rather foliaceous and erect bracts: rays 8 to 12: pappus a *very narrow crown*, extended into 3 or 4 stout subulate teeth, or into 1 or 2 short awns. — Proc. Am. Acad. viii. 655. S. Colorado to S. Utah and Arizona.

4. **W. scabra**, Hook. *Very scabrous*, a foot or two high, rigid: cauline leaves linear, thick, 4 to 6 inches long, $\frac{1}{2}$ inch wide, sessile, attenuate-acute: involucre bracts imbricated in 3 or 4 series, all the outer with an appressed base, which is *acuminate into a longer subulate filiform spreading very hispid-scabrous appendage*: rays several, $\frac{1}{2}$ inch long: akenes acutely angled, the 3 or 4 angles extended into a pappus of as many short blunt teeth, which are *barely confluent* at base. — New Mexico and S. Colorado to Utah and Wyoming.

38. GYMNOLOMIA, HBK.

With erect branching stems, alternate or opposite leaves, and heads of yellow flowers; resembling small-flowered species of *Helianthus*.

1. **G. multiflora**, Benth. & Hook. A foot to a yard high, pubescent or scabrous, sometimes also hispid, often much branched: leaves from narrowly linear to lanceolate, either alternate or mainly opposite, entire or obscurely denticulate: rays 10 to 15, golden yellow: disk hemispherical, in age little more elevated and receptacle obtusely conical; its bracts linear, obtuse or the inner acute: akenes smooth. — *Helimeris multiflora*, Nutt. Very polymorphous. From Arizona to Wyoming and W. Texas.

39. HELIANTHUS, L. SUNFLOWER.

Usually tall or coarse; with a part or all the leaves opposite and simple; heads peduncled and terminating the stems or branches, with yellow rays, and either yellow or purple disk-flowers.

§ 1. *Annuals: receptacle flat or nearly so: all but the lower leaves usually alternate, petioled, 3-ribbed: involucre spreading; its bracts attenuate: disk brownish or dark purple.*

1. **H. annuus**, L. *Robust, when well developed tall, hispid, hispidulous, or scabrous: stem often spotted or mottled: leaves ovate and the lower cordate, serrate, the larger 6 to 12 inches long, the blade of the cauline ones longer than their petiole: bracts of the involucre from broadly ovate to oblong, aristiform-acuminate, below hispidly ciliate: disk in the wild plant commonly an inch or more in diameter. — Includes H. lenticularis, Dougl., and many other forms. From the Saskatchewan to Texas and westward. The "Common Sunflower," extensively cultivated everywhere and thus becoming very tall and with enormous heads. Fruit used by the Indians for food and oil.*

2. **H. petiolaris**, Nutt. *A foot to a yard high, more slender, loosely branching, strigose-hispidulous, rarely hirsute: leaves oblong-lanceolate or ovate-lanceolate, entire or sparingly denticulate, 1 to 3 inches long, cuneately attenuate or the lower abruptly contracted into a long and slender petiole: bracts of the involucre lanceolate or oblong lanceolate, with acute and mucronate or sometimes more attenuate tips, seldom at all ciliate: disk $\frac{1}{2}$ inch or more in diameter. — About the same range as the last.*

§ 2. *Perennials: receptacle convex, or at length low-conical: lower leaves almost always opposite.*

* *Involucre loose, becoming more or less squarrose; its bracts almost equal, filiform-attenuate: disk usually dark purple or turning brownish: all but the lower leaves long-linear or filiform.*

3. **H. orgyalis**, DC. *Stem smooth and glabrous, often 10 feet high, very leafy to the top: leaves mostly alternate, from long-linear, 8 to 16 inches long, commonly 2 to 4 lines wide, or the lowest lanceolate, to almost filiform, slightly papillose-scabrous, the lower narrowed into a petiole and sometimes serrulate: bracts of the involucre filiform-attenuate, those of the receptacle entire: akenes oblong-obovate with a rounded summit, 3 lines long. — Dry plains, Nebraska to Texas, west to S. E. Colorado.*

* * *Involucre closer, of more imbricated and unequal ovate or oblong but not foliaceous bracts: leaves from lanceolate to ovate: herbage not tomentose nor conspicuously cinereous.*

4. **H. rigidus**, Desf. *A foot or two (rarely 6 to 8 feet) high, rigid, sparingly branched: leaves very firm-coriaceous and thick, both sides hispidulous-scabrous, sage-green-like, entire or serrate; lower oblong and ovate-lanceolate, attenuate at base into short winged petioles; upper mostly lanceolate: heads comparatively large, showy; disk $\frac{3}{4}$ inch high, dark purple or brownish: involucre pluriserially imbricated; its bracts mainly ovate, obtuse or acutish, rigid, appressed, densely and minutely ciliate. — Plains and prairies from Michigan to Texas and west to E. Colorado.*

5. **H. pumilus**, Nutt. *Hispid and scabrous throughout: stems simple, a foot or two high, bearing 5 to 7 pairs of leaves and a few rather short-peduncled heads: leaves mostly ovate-lanceolate, acute, entire or nearly so, $1\frac{1}{2}$ to 4 inches long, rigid, abruptly contracted at base into a short margined petiole: involucre less than half-inch high, white hirsute or scabro-hispidulous; its bracts*

imbricated in about 3 series, oblong-lanceolate, acutish: disk yellow. — Eastern Rocky Mountains and adjacent plains, from Wyoming to Colorado.

* * * *Involucre looser and the bracts disposed to be more taper-pointed, or foliaceous: disk yellow or yellowish.*

+ *Stems smooth or somewhat scabrous: leaves mostly lanceolate or narrower: involucre bracts linear-subulate, loose or soon squarrose-spreading.*

6. **H. grosse-serratus**, Martens. *Stem very smooth and glabrous, commonly glaucous, 6 to 10 feet high, bearing numerous rather cymosely disposed and short-peduncled heads: leaves slender-petioled, thinnish, oblong lanceolate or narrower, or some of the cauline almost deltoid-lanceolate, gradually acuminate, sharply serrate, or upper merely denticulate, slightly scabrous above, whitish and soft-puberulent beneath: larger cauline commonly 8 to 10 inches and the petiole an inch or two long: deep yellow oblong rays over an inch long.* — Dry plains, from Texas to the Dakotas and as far east as Ohio.

7. **H. Maximiliani**, Schrader. *Hispidulo is-scabrous: stem stout, 2 or 3 (and even 10 to 12) feet high, below mostly rough-hispid: leaves almost all alternate, thickish, becoming rigid, very scabrous above, lanceolate, acute or acuminate at both ends, mostly sessile, all entire or sparingly denticulate: involucre of more rigid bracts: rays numerous, often inch and a half long, golden yellow.* — Prairies and plains west of the Mississippi, and from the Saskatchewan to Texas.

8. **H. Nuttallii**, Torr. & Gray. *Stem slender, 2 to 4 feet high, commonly simple, smooth and glabrous: leaves lanceolate or the upper linear, 3 to 6 inches long, 3 to 9 lines wide, short-petioled or sessile, serrulate or entire: bracts of the involucre naked or somewhat hirsute at base: paleæ of the pappus long and narrow.* — Fl. ii. 324. In wet soil, W. Wyoming and Utah to Oregon, Washington, and British Columbia

+ + *Stems pubescent or hirsute: leaves ovate or subcordate: involucre bracts lanceolate, loose, hirsute-ciliate.*

9. **H. tuberosus**, L. *Stem 5 to 10 feet high, branching at summit: leaves mostly alternate on the branches, acuminate, dull green, minutely pubescent and occasionally cinereous beneath, soon scabrous above: bracts of the involucre attenuate-acuminate: rays often inch and a half long, 12 to 20: bracts of the receptacle hirsute-pubescent on the back: akenes more or less pubescent at summit and margins, mostly long and slender.* — The "Jerusalem Artichoke," widely cultivated for its fleshy tubers, and found under various forms, especially in the E. United States. An indigenous form coming within our range is

Var. **subcanescens**, Gray. *Mostly dwarf, about 2 feet high, comparatively small-leaved, rough-hispidulous or scabrous, but the lower face of the leaves whitish with soft and fine pubescence.* — Synopt. Fl. i. 280. Plains of Minnesota, Dakotas, etc.

40. **HELIANTHELLA**, Torr. & Gray.

Leafy-stemmed: leaves lanceolate to ovate, with tapering base, opposite or alternate: rays broad, yellow: disk yellow or purplish-brown: akenes flat, from cuneate-obovate and emarginate to slightly obcordate.

* *Chaffy bracts of the receptacle soft and scarious: akenes with some long villous hairs on the margins and sometimes on the faces.*

+ Heads showy, large or middle-sized, solitary, or some later ones axillary: bracts of the involucre loose and lanceolate-attenuate or linear, more or less foliaceous, conspicuously hirsute-ciliate: disk yellowish.

1. **H. quinquenervis**, Gray. Somewhat hirsutely pubescent or almost glabrous: stems solitary or scattered, 2 to 4 feet high: leaves mostly opposite, oblong- or ovate-lanceolate, acuminate, 4 to 9 inches long, uppermost sessile, lower ones tapering into margined petioles, and the lowest (a foot or more long) into longer petioles: head mostly long-peduncled, ample, the disk a full inch in diameter: rays 15 to 20, pale yellow, commonly inch and a half long: pappus of 2 slender awns, of half the length of the akenes, and nearly thrice the length of the squamellæ, which form a conspicuous finely dissected fringe. — Proc. Am. Acad. xix. 10. *H. uniflora* of the Fl. Colorado and Bot. King's Exp. Mountains from South Dakota and Montana to S. Colorado.

2. **H. Parryi**, Gray. Hispidulous-hirsute: stems numerous from a thickened root, a foot high, rather slender: leaves mostly alternate, more rigid, lanceolate and an inch or two long, or the lowest and radical oblong-spatulate and of double the size: heads and rays barely half the size of the preceding: pappus of fimbriately dissected squamellæ only, or with a pair of slender awns not surpassing these. — Proc. Acad. Philad. 1863, 68. Mountains of Colorado and New Mexico.

+ + Heads small: involucre more imbricated: rays few and hardly surpassing the dark purple disk.

3. **H. microcephala**, Gray. Hispidulous-scabrous: stems numerous from a greatly thickened root, a foot or less high, slender, somewhat paniculately or corymbosely branched at summit and bearing several heads: leaves rigid, all but the lower alternate; radical lanceolate-spatulate; upper cauline nearly linear and sessile, an inch long: involucre bracts linear oblong, mostly obtuse: rays not over 3 lines long: pappus of several slender squamellæ intermixed with the long hairs, two marginal ones often extended and awn-like. — Proc. Am. Acad. xix. 10. Borders of Colorado and adjacent New Mexico and Utah.

* * *Chaffy bracts of the receptacle firm-chartaceous: stems a foot or two high.*

4. **H. uniflora**, Torr. & Gray. Minutely pubescent or glabrate: leaves more commonly opposite, sometimes all alternate, oblong-lanceolate, 2 to 5 inches long; lower short-petioled: involucre pubescent or slightly hirsute: rays a full inch long: akenes more or less ciliate: pappus a pair of long awns and rather conspicuous squamellæ. — Gray, Proc. Am. Acad. xix. 10. *H. multicaulis* of Bot. King's Exp. Mountains of Montana and E. Idaho to S. Utah.

41. VERBESINA, L.

Flowers yellow or rarely white. Ours belongs to § *Ximenesia*, in which the heads are broad, the involucre of spreading linear and foliaceous equal bracts, and the disk and receptacle merely convex: the rays are numerous and conspicuous.

1. **V. encelioides**, Benth. & Hook. A foot or two high, freely branching, pale and cinereous or sometimes canescent: leaves mostly alternate, and the upper face green, from ovate or cordate to deltoid-lanceolate, variously serrate or laciniate-dentate, most with winged petioles, and commonly with auriculate-dilated appendage at base: disk three fourths inch in diameter: rays 12 to 15, an inch long, deeply 3-cleft at summit: akenes obovate, mostly broadly winged and with short awns. — *Ximenesia encelioides*, Cav. From S. Colorado and Arizona to Texas.

42. COREOPSIS, L. TICKSEED.

Pedunculate heads terminating the branches: rays mostly showy, yellow, partly-colored, or rose-colored. In ours the akene is wingless.

1. **C. tinctoria**, Nutt. Glabrous, 2 or 3 feet high: leaves opposite and all 1 to 2-pinnately divided into lanceolate or linear divisions: outer involucre short and close: rays $\frac{1}{2}$ to $\frac{3}{4}$ inch long, either yellow with crimson-brown base or nearly all crimson brown: disk-flowers dark purple or brown: akenes moderately incurved: pappus none or an obscure border. — From Colorado and Arizona to the Saskatchewan and Texas.

2. **C. involucrata**, Nutt. Somewhat pubescent or glabrous, 1 to 3 feet high: leaves opposite and all pinnately 3 to 7-divided or parted; the divisions serrate, incised, or again cleft: bracts of the outer involucre 12 to 20, mostly surpassing the inner, slender, hispid on the back and margins: rays sometimes an inch long, golden yellow: disk-flowers dull yellow: akenes straight, with 2 short acute teeth. — Plains of E. Colorado to Texas and W. Illinois.

43. BIDENS, Tourn. BUR-MARIGOLD.

Leaves opposite, simple or compound: heads of mostly yellow flowers solitary or paniculate.

§ 1. Akenes flat, from obovate to cuneiform, not at all contracted at summit, 2 to 4-awned: outer involucre foliaceous and spreading.

* Heads erect, rayless, or rarely with 1 to 5 small rays: disk greenish yellow: leaves mostly petioled and divided.

1. **B. frondosa**, L. Glabrous or somewhat hairy, branching, 2 to 6 feet high: leaves except the uppermost pinnately 3 to 5-divided into lanceolate or broader sharply serrate petiolulate leaflets: outer involucre often very leafy: akenes obovate or oblong, more or less hairy, 2-awned. — Shady or moist rich ground, common everywhere. The common "Stick-tight."

* * Heads commonly with conspicuous rays: leaves all sessile and undivided; upper pairs somewhat connate round the stem: margins of the cuneate akenes and the rigid awns retrorsely hispid.

2. **B. cernua**, L. Stem glabrous or setulose hispid, from a span to a yard high: leaves oblong-lanceolate, coarsely and irregularly sharply serrate: heads conspicuously nodding after anthesis, commonly surpassed by the foliaceous outer involucre: rays ovate or oval, little surpassing the disk or wanting: akenes usually 4 awned. — Across the continent, especially in the more northern latitudes. In wet grounds.

3. **B. chrysanthemoides**, Michx. Glabrous, often decumbent at base, a foot or two high: leaves lanceolate, *rather minutely and evenly serrate*: heads rather large, *little or not at all nodding*: outer involucre seldom surpassing the inner, *conspicuously surpassed by the oval or broadly oblong rays*: akenes 2 to 4-awned. — Wet grounds, across the continent; on the plains around Denver.

§ 2. *Akenes narrow, linear-tetragonal; the outer shorter and more truncate than the inner, which generally taper upward: outer involucre seldom foliaceous or enlarged: leaves (in ours) all once to thrice 3 to 5-nately parted or divided, and the rays inconspicuous or none.*

4. **B. bipinnata**, L. Primary and secondary divisions of the leaves rather ovate or deltoid-lanceolate in circumscription, and the lobes mostly acute: akenes all slender, the inner ones 5 to 9 lines long, outermost moderately shorter and thicker: awns 3 or 4, sometimes only 2. — A common weed in waste ground throughout the continent. Commonly known as "Spanish Needles."

5. **B. tenuisecta**, Gray. A foot or two high, branched from the base, sparsely hirsute or glabrous: leaves 2 to 3-ternately or pinnately dissected into narrow linear lobes: heads on naked rather long and stout peduncles, many-flowered, 4 or 5 lines high in flower: akenes glabrous, 2-awned; inner 5 lines long, with tapering summit; outermost 3 lines long, stouter and with broad summit and usually short awns: rays yellow, mostly surpassing the disk. — Pl. Fendl. 86. Along water-courses, Colorado, New Mexico, and Arizona.

44. THELESPERMA, Less.

Smooth and glabrous perennials: with opposite usually finely dissected leaves, and pedunculate heads: the rays golden yellow.

* *Lobes of the disk-corollas linear or lanceolate, longer than the throat: pappus evident: chaff of receptacle falling with and partly embracing the akenes.*

1. **T. ambiguum**, Gray. A foot high, spreading by creeping rootstocks, rather rigid and naked above: leaves bipinnately divided into narrowly linear or filiform lobes: bracts of the outer involucre 8, subulate-linear, almost equalling or half the length of the inner, which are connate to or above the middle: rays broad, over $\frac{1}{2}$ inch long, rarely wanting: disk usually purple turning brownish: outer akenes becoming coarsely papillose; the stout pappus-scales not longer than the width of the akene. — Proc. Am. Acad. xix. 16. *T. filifolium* of most of the Western Reports. From Montana to Colorado, New Mexico, and W. Texas.

2. **T. gracile**, Gray. More rigid, a foot or two high, from a deep root, less branched, naked above: leaves once or twice 3 to 5-nately divided or parted into filiform-linear or broader lobes, or some upper ones filiform and entire: bracts of the outer involucre 4 to 6, very short, ovate or oblong; of the inner one connate to above the middle, the edges of their lobes slightly scarios: disk mostly yellow, scarcely brownish after anthesis: akenes less papillose or roughened, the breadth of the summit exceeded by the subulate awns: rays usually none, rarely present and 2 or 3 lines long, — Loc. cit. Plains, Nebraska and Wyoming to W. Texas and Arizona.

* * *Lobes of disk-corollas ovate or oblong, decidedly shorter than the throat: pappus shorter and coroniform or obsolete: very leafy below, sending up long and naked peduncles: outer involucre short.*

3. **T. subnudum**, Gray. Rather stout: leaves thickish and rigid, once or twice ternately parted into linear or lanceolate lobes: peduncles 4 to 10 inches long: head $\frac{1}{2}$ inch high: rays sometimes none, sometimes ample: pappus a minute 4 to 5-toothed naked crown, or obsolete. — Proc. Am. Acad. x. 72. Green River, Wyoming, *Parr.*; mainly in New Mexico, N. Arizona, and S. Utah.

45. **MADIA**, Molina. TARWEED.

Glandular and viscid herbs, mostly heavy-scented: with entire or merely toothed leaves, some or all of them alternate: heads axillary and terminal. Ours belongs to the § *Enmadia*, in which the rays are few and inconspicuous or none and the pappus none.

1. **M. glomerata**, Hook. A foot or so high, rigid, very leafy, hirsute, glandular only toward the inflorescence: leaves narrowly linear: heads glomerate: rays 2 to 5 or sometimes none, not surpassing the about equal number of disk-flowers: akenes narrow, those of the disk 4 to 5-angled; of the ray somewhat curved and 1-nerved on each face. — Mountains of Colorado, to the Saskatchewan, the Sierras of California, Oregon, and Washington.

46. **LAYIA**, Hook. & Arn.

Branches terminated by showy heads of (in ours) white flowers: pappus of 10 to 20 stout bristles, which are plumose below the middle: herbage hispid or hirsute, somewhat viscid, above beset with scattered stipitate blackish glands.

1. **L. glandulosa**, Hook. & Arn. A span to a foot or more high, diffusely branched: lower leaves lanceolate or linear, laciniate-pinnatifid or incised, upper narrow and entire: rays 8 to 13, large and conspicuous (bright white or tinged with rose), $\frac{1}{2}$ to $\frac{3}{4}$ inch long, 3-lobed: villous hairs of the pappus bristles copious, the outer straight and erect, the inner soon crisped and interlaced into a woolly mass. — Barren ground, from New Mexico through S. W. Colorado to Idaho, and westward.

47. **RIDDELLIA**, Nutt.

Lew and corymbosely branched woolly herbs: with alternate and spatulate or linear leaves, the cauline entire: small heads of yellow flowers: bracts of the involucre distinct, but connected by the intricate wool so as to seem connate.

1. **R. tagetina**, Nutt. Loosely or somewhat villosely lanate, sometimes glabrate in age, rather widely branched: radical and even lower cauline leaves often laciniate-pinnatifid: heads numerous, mostly cymosely clustered and short-peduncled: scales of the pappus oblong-lanceolate, entire, usually obtuse, $\frac{1}{2}$ or $\frac{3}{4}$ the length of the disk-corolla. — W. Texas to E. Colorado and Arizona.

48. PERICOME, Gray.

The name refers to the coma of long hairs all round the margin of the akenes.

1. *P. caudata*, Gray. Rather tall, widely branching, strong-scented, very minutely puberulent: leaves opposite, long-petioled, green and minutely somewhat resinous-atominiferous, triangular-hastate, 2 to 5 inches long, with sparingly crenate-dentate or entire margins, caudately long-acuminate, as also in less degree are the basal angles: heads numerous in terminal corymbiform cymes, half-inch or less high; flowers golden yellow, conspicuously longer than the glabrous involucre: pappus a crown of hyaline scales which are more or less connate and fimbriate-lacerate at summit, the fringe dissected into bristles or hairs somewhat simulating those of the margin of the akene. — Pl. Wright. ii. 82. Rocky cañons, etc., S. Colorado, New Mexico, and Arizona.

49. ERIOPHYLLUM, Lag.

Mostly floccose herbs: with alternate or partly opposite leaves, and peduncled heads: flowers golden yellow. In ours the heads are mostly solitary or scattered and conspicuously pedunculate.

1. *E. cæspitosum*, Dougl. Floccosely white-woolly, many-stemmed from the root: leaves in age with upper face often glabrate; lower ones from spatulate or cuneate to roundish in outline, from incisely 3 to 5-lobed to pinnately parted or the upper varying to linear and entire: involueral bracts 8 to 12, oblong or oval: tube of disk-corollas mostly hirsute-glandular and longer than the pappus, which is variable, sometimes very short, sometimes obsolete. — *Bahia lanata*, DC. Common from Montana to British Columbia and thence southward. Very variable, one form within our range being

Var. *integrifolium*, Gray. Low, often dwarf, caespitose-tufted, 3 to 10 inches high: leaves from narrowly spatulate or oblanceolate and entire to more dilated and 3-lobed at summit, or at base and on sterile shoots cuneate and incisely lobed: involucre of 6 bracts: pappus about equalling the very glandular but not hirsute corolla-tube. — Proc. Am. Acad. xix. 25. *Bahia integrifolia*, DC. Mountains of Wyoming, Montana, and westward.

50. BAHIA, Lag.

Sometimes canescent but not woolly: with opposite or sometimes alternate leaves, and rather small pedunculate heads of yellow flowers terminating the branches

* *Scales of the pappus 4 to 8, obovate or spatulate, with rounded or truncate scarious summit: leaves dissected or cleft, mostly opposite.*

1. *B. oppositifolia*, Nutt. A span or two high, fastigiately branched and many-stemmed, very leafy up to the short-peduncled heads, cinereous with fine close pubescence: leaves petioled, palmately or pedately 3 to 5-parted into linear divisions little broader than the margined petiole: bracts of the involucre oblong or oval, comparatively close: rays 5 or 6, oval, hardly surpassing the disk-flowers: akenes slender, glandular: pappus half the length of the corolla-tube. — Sterile hills and plains, Nebraska to Colorado and New Mexico.

* * *Scales of the pappus about 10, linear-lanceolate, and with a distinct rib: leaves all alternate and entire.*

2. **B. nudicaulis**, Gray. Cinereous-puberulent and glabrate, upper part of the scapiform stem and involucre minutely glandular, a span or two high: leaves nearly all radical, oval or spatulate-oblong, tapering into a slender petiole: heads solitary or few and somewhat corymbosely paniculate, nearly $\frac{1}{2}$ inch high: involucre of about 10 oblong bracts: rays 6 to 9, oblong: pappus fully half the length of the cuneate-linear sparsely hairy akene: the thin margins of the paleæ of the pappus erose.—Proc. Am. Acad. xix. 27. Wind River Mountains, N. W. Wyoming, Parry.

3. **B. oblongifolia**, Gray. Smaller: stems sparsely leafy almost to the 3-cephalous naked inflorescence: leaves narrowly oblong: head only 4 lines high, narrow: paleæ of the pappus firmer, smoother, and with entire edges, little shorter than the glabrate akene.—Loc. cit. On the San Juan and Rio Colorado, S. E. Utah or adjacent Colorado.

* * * *Leaves once or twice palmately or pedately divided: akenes mostly hirsute along the slender attenuate base.*

+ *Leaves mainly opposite: rays none: pappus of broad and very obtuse scales.*

4. **B. Neo-Mexicana**, Gray. A span or more high, minutely puberulent: leaves 3 to 7-parted into narrow linear divisions: uppermost little shorter than the slender peduncles. involucre of about 10 sparingly pubescent spatulate bracts: disk-corollas small, with glandular tube, almost equalled by the obovate scales of the pappus, which are much thickened at and near the base.—Proc. Am. Acad. xix. 27. New Mexico and S. Colorado.

+ + *Leaves mainly alternate: rays 16 to 20, obovate-oblong, yellow: pappus none.*

5. **B. chrysanthemoides**, Gray. Taller and stouter, 1 to 4 feet high, puberulent or below glabrous, above with the flowering branches and short peduncles glandular pubescent and viscid: leaves 1 to 3-ternately divided or parted; the lobes from oblong and obtuse to nearly linear: heads 5 or 6 lines high and broad: bracts of the involucre 16 to 20, crowded, from oblong-lanceolate to obovate-oblong, most of them conspicuously acuminate.—Proc. Am. Acad. xix. 28. *Villanora chrysanthemoides*, Gray. Along mountain-water-courses, Colorado to S. Arizona.

51. HYMENOPAPPUS, L'Her.

Mostly floccose-tomentose and with sulcate-angled erect stems, alternate mostly 1 to 2-pinnatifid or parted leaves, and cymose or solitary pedunculate heads of white or yellow flowers

* *Flowers white; the tube long and slender and stamens much exerted: pappus of very small scales forming a crown, or obsolete: akenes puberulent: involucre of partly white-petaloid bracts.*

1. **H. corymbosus**, Torr. & Gray. Slender and glabrate, naked above: lower leaves 2-pinnately and the small upper ones mostly simply parted into narrowly linear acute divisions and lobes: heads 3 or 4 lines high: bracts of the involucre shorter than the flowers, obovate-oblong, the petaloid summit

only greenish white: akenes puberulent. — Fl. ii. 372. Prairies, Nebraska to Arkansas and Texas, extending westward to within the eastern limits of our range.

* * *Flowers dull white to yellow: pappus conspicuous, of spatulate or narrow scales which have a manifest rib: akenes villous: involucre greener, less petaloid.*

2. *H. tenuifolius*, Pursh. *Lightly tomentose, or soon glabrate and green, leafy: leaves rather rigid, once or twice pinnately parted into very narrowly linear or filiform divisions, their margins soon revolute: heads only 3 or 4 lines high, numerous and cymose: involucre rather erect and close; its bracts oblong-obovate, greenish with whitish apex and margins: corolla dull white: akenes long-villous.* — Fl. ii. 742. Plains, from Nebraska to Arkansas, Texas, and Utah.

3. *H. filifolius*, Hook. *Tomentose-canescant, or somewhat denudate and glabrate, naked above: stems a span to a foot high, sometimes scapiform: leaves nearly as in the last, or of more filiform rigid divisions: heads a third to half inch high, few or solitary: bracts of the involucre oblong or obovate-oblong, largely green or else white-woolly, the tips whitish or purplish-tinged: corolla yellowish white or sometimes clear yellow: akenes very long-villous.* — Probably the *H. tenuifolius* of Fl. Colorado as well as of Bot. King's Exp. From Nebraska and Montana to New Mexico and S. California.

52. POLYPTERIS, Nutt.

Herbs more or less scabrous-pubescent: with undivided and mostly entire petiolate leaves, all or the upper alternate: loosely cymose or paniculate and pedunculate heads of rose-purple flowers. In ours the rays are palmately 3-cleft.

1. *P. Hookeriana*, Gray. Stout, 1 to 4 feet high, above glandular-pubescent and somewhat viscid: leaves from narrowly to broadly lanceolate: involucre many-flowered, broad, $\frac{1}{2}$ inch or more high, of 12 to 16 lanceolate bracts in two series, the outer looser and often wholly herbaceous, inner with purplish tips: ray-flowers 8 to 10, the rose-red rays $\frac{1}{2}$ inch long, but sometimes reduced or abortive: pappus of the disk of thin scales attenuate at apex into a slender point or short awn, nearly the length of the akene. — Proc. Am. Acad. xix. 30. Sandy plains, from Nebraska to Texas, and extending within the eastern limits of our range.

53. CHÆNACTIS, DC.

With alternate mostly pinnately dissected leaves, pedunculate solitary or cymose heads of yellow or (in ours) white or flesh-colored flowers, and pappus mostly of entire or merely erose persistent scales (in ours 8 to 14).

1. *C. Douglasii*, Hook. & Arn. Canescent with a fine somewhat floccose tomentum, or sometimes glabrate, a span to a foot or more high: leaves mostly of broad outline and bipinnately parted into crowded short and very obtuse divisions and lobes: heads from $\frac{1}{2}$ to $\frac{3}{4}$ inch long, in larger plants several or numerous and corymbosely cymose: scales of the pappus from linear-ligulate

to narrowly oblong and from $\frac{1}{2}$ to $\frac{3}{4}$ the length of the corolla. — From Montana to New Mexico and westward.

Var. **alpina**, Gray. Dwarf, 3 to 5 inches high, consisting of a rosette or thick tuft of leaves with very approximate divisions, and naked or scapiform stems, bearing mostly solitary heads, surmounting the subterranean branches of a multicapital perennial caudex or rootstock. — Synopt. Fl. i. 341. Alpine region of the mountains of Colorado and Wyoming, California, and north to Washington.

54. ACTINELLA, Pers., Nutt.

Low mostly herbaceous plants: with punctate and often resinous-atomiferous, aromatic herbage: leaves all alternate and narrow or with narrow lobes: the heads of yellow flowers commonly slender-pedunculate.

§ 1. *Involucre of numerous herbaceous or nearly membranous nearly equal and similar bracts, distinct to the base: heads mostly solitary on long or scapiform peduncles, rarely sessile in the cluster of leaves.*

* *Leaves mostly quite entire, all on the crowns of the caudex, which bear a simple scapiform peduncle (or none): involucre villous-lanate: scales of the pappus usually produced at apex into an awn.*

1. **A. scaposa**, Nutt. *Loosely villous and glabrate, rather sparsely caespitose, the branches of the caudex being slender and often ascending: scape a span to a foot high, occasionally leafy along the base: leaves linear to lanceolate or some of the earlier ones spatulate, not rarely laciniate-lobed.* — From Texas and New Mexico, but extending into Colorado under the following form:

Var. **linearis**, Nutt. Leaves all narrowly linear and entire, more rigid.

2. **A. acaulis**, Nutt. *Densely caespitose, the branches of the caudex short, thick, and crowded, canescently villous or sericeous, sometimes more naked: leaves thickish, all entire, from spatulate to nearly linear, commonly short, $\frac{1}{2}$ inch to 2 inches long, densely crowded on the caudex: scape $\frac{1}{2}$ inch to 6 inches high: rays 3 to 5 inches long (rarely wanting).* — Mountains and the bordering plains and hills, South Dakota to Montana, and south to New Mexico and Arizona.

Var. **glabra**, Gray. Leaves green, spatulate-linear, from sparingly villous or glabrate to nearly glabrous, even to the base and axils. — Man. 363. Rocky hills and bluffs, Wyoming to New Mexico and Utah.

3. **A. depressa**, Torr. & Gray. *Pulvinate-caespitose: leaves densely crowded on the very thick dense branches of the caudex, spatulate-linear, $\frac{1}{2}$ inch long, either sericeous-canescenscent or glabrate: head strictly sessile, immersed among the long-villous bases of the leaves.* — Pl. Fendl. 100. Mountains of W. Colorado or E. Utah.

* * *Leaves all quite entire, crowded on the caudex, also scattered along the simple or sparingly branched stems: peduncles slender: heads, etc., as in the last group.*

4. **A. leptoclada**, Gray. A span or two high, slender, sparsely and loosely silky-villous, glabrate, the linear leaves and lower part of the stems not rarely glabrous. — Pacif. R. Rep. iv. 107. New Mexico and S. W. Colorado.

* * * *Leaves mostly parted or dissected into narrow linear lobes, crowded on the thick comparatively simple caudex and scattered on the short flowering stems: heads large: involucre very woolly: scales of the pappus attenuate into a subulate but hardly awned point.*

5. **A. Brandegei**, Porter. *Leaves glabrate, with 2 or 3 lobes toward the upper part, or some entire, narrowly linear, only 2 or 3 on the somewhat scapiform simple flowering stem (a span or more in height): head therefore conspicuous, pedunculate, $\frac{1}{2}$ inch high and wide: involucre bracts lanceolate: rays 12 to 16, 3 or 4 lines long.* — Gray, Proc. Am. Acad. xiii. 373. *A. grandiflora*, var. *glabrata*, Porter, Fl. Colorado. 76. Alpine region of the mountains of S. Colorado.

6. **A. grandiflora**, Torr. & Gray. *A span or two high, very stout, floccose-woolly, somewhat glabrate in age: stem simple or branching below, leafy: leaves with petiole scarious-dilated at base, lower ones 2 to 3-ternately or quinate parted, upper with 3 to 5 simple lobes: involucre about an inch broad, very woolly: its bracts linear: rays 30 or more, over $\frac{1}{2}$ inch long.* — Alpine regions, from Montana to Colorado.

§ 2. *Involucre double or of two distinct series of coriaceous or rigid appressed bracts, the outer connate at base: leafy-stemmed and branching.*

7. **A. Richardsonii**, Nutt. *A span to a foot high, in tufts from a multicapital caudex, puberulent or nearly glabrous, woolly in the axils of radical leaves, polycephalous: upper leaves mostly once and lower twice ternately parted into long and simple filiform-linear lobes, rather rigid: involucre 2 or 3 lines high, 6 to 9-angled; the 6 to 9 bracts of the outer strongly carinate, united for the lower quarter or third: rays broadly or sometimes narrowly cuneate, 2 to 4 lines long.* — Plains, Saskatchewan and E. Oregon to Utah and New Mexico.

55. HELENIUM, L. SNEEZE-WEED.

Herbs, with alternate simple leaves, commonly resinous-atomiferous and punctate, and with pedunculate heads of yellow flowers.

* *Leaves not decurrent, entire: rays long and narrow: bracts of the involucre numerous in two series, tardily reflexed in fruit: heads comparatively few and large.*

1. **H. Hoopesii**, Gray. *Slightly tomentose or pubescent when young, soon glabrate: stem stout, 1 to 3 feet high, leafy, bearing several or sometimes solitary large heads: leaves thickish, oblong-lanceolate, or the lower spatulate with long tapering base: rays becoming an inch long, tardily reflexed: disk $\frac{1}{2}$ to $\frac{3}{4}$ inch high, hemispherical: scales of the pappus ovate-lanceolate, long attenuate-acuminate, a little shorter than the corolla.* — Proc. Acad. Philad. 1863, 65. Mountains of Montana to New Mexico, Arizona, and California.

* * *Stem winged by the decurrent serrate or denticulate leaves: rays cuneate or oblong, soon drooping: involucre small and simple, of linear or subulate bracts, soon reflexed: heads more numerous (corymbose) and smaller.*

2. **H. autumnale**, L. *Nearly glabrous or minutely pubescent: stem very leafy, narrowly winged, 2 to 6 feet high: leaves lanceolate to ovate-oblong: heads about $\frac{1}{2}$ inch in diameter, usually equalled by the rays: pappus*

commonly $\frac{1}{2}$ or $\frac{2}{3}$ the length of disk-corolla. — From Arizona to British Columbia and eastward across the continent.

56. GAILLARDIA, Fougereux.

Herbs, with alternate leaves, and ample showy heads on terminal peduncles. Ours are more or less pubescent or hirsute and leafy-stemmed, with yellow rays and disk-flowers apt to turn brown, villous akenes, and scales of the pappus slender-awned.

1. *G. aristata*, Pursh. *More or less hirsute*, often 2 feet or more high: *leaves lanceolate or broader, or lower spatulate, from entire to laciniate-dentate or sinuate-pinnatifid*: rays in the largest heads $1\frac{1}{2}$ inches long: *lobes of disk-corolla subulate-acute and tipped with a cusp*: *pappus aristate*. — From New Mexico and S. Colorado to Oregon, British Columbia, and the Saskatchewan.

2. *G. pinnatifida*, Torr. *Cinereous-pubescent*: peduncles scapiform or from short leafy stems, 5 to 10 inches long: some or even all the *leaves pinnatifid*, sometimes linear or with linear lobes, sometimes spatulate and sinuate or even entire: *teeth of the disk-corolla short and broad, obtuse, pointless*: *pappus-scales lanceolate*. — On the plains, Colorado and Arizona to W. Texas.

57. FLAVERIA, Juss.

Glabrous herbs; with small and fascicled or glomerate heads of yellowish or yellow flowers, and opposite sessile leaves; akenes mostly smooth and glabrous.

1. *F. angustifolia*, Pers. Erect, a foot or two high: leaves from linear to lanceolate, serrulate or entire, sessile by broadish or little contracted base: heads in subsessile or short-pedunculate or leafy-involucrate chiefly terminal glomerules: involucre of mostly 3 bracts, 3 to 5-flowered or some only 2-flowered. — Alkaline soil, E. Colorado and New Mexico to W. Texas.

58. DYSODIA, Cav. FETID MARIGOLD.

Herbs, mostly strong-scented, with alternate or opposite leaves, and solitary or somewhat paniculate heads of yellow flowers. Ours has an involucre with accessory bracts, pubescent akenes, and opposite pinnately divided leaves.

1. *D. chrysanthemoides*, Lag. Much-branched and ill-scented annual, leafy up to the subsessile or short-pedunculate small heads: leaves 1 to 2-pinnately parted into linear lobes: involucre purplish-tinged or greenish, of 8 or 10 scarious-tipped oblong bracts, and some linear loose accessory ones: rays few and inconspicuous, not surpassing the disk. — From Arizona and Colorado to Minnesota and Louisiana, and now spreading eastward to the Atlantic States.

59. HYMENATHERUM, Cass.

Low herbs, mostly pleasant-scented; with alternate or opposite leaves, and rather small radiate heads of yellow flowers. Our species is wholly glabrous.

1. *H. aureum*, Gray. A span or two high, erect or diffuse, much branched, bearing numerous short-peduncled heads: leaves mostly alternate,

pinnately parted into 7 to 9 linear-filiform pointless divisions: involucre 3 lines high: rays about 12, oblong, 3 lines long: pappus of 6 or 8 quadrate or oblong and crose-truncate scales, in length little exceeding the breadth of the akenes — Proc. Am. Acad. xix. 42. Plains of Colorado to W. Texas.

O. PECTIS, L.

Mostly low and spreading herbs, usually glabrous and scented; with narrow opposite leaves conspicuously dotted with round oil-glands; small heads of yellow flowers; and slender rigid bristles fringing at least the base of the leaves.

1. *P. angustifolia*, Torr. A span or two high, lemon-scented: leaves narrow-linear: heads subsessile or short-peduncled, fastigate or cymose at the end of the branches: bracts of the involucre about 8, linear, at length with involute margins: pappus a crown of 4 or 5 mostly connate scales, and not rarely one or two slender usually short awns. — Ann. Lyc. N. Y. ii. 214. Dry ground, Colorado and Arizona to Texas.

61. LEUCAMPYX, Gray.

Named from the circle of bracts of the head being white-bordered.

1. *L. Newberryi*, Gray. Perennial herb, a foot or two high, flocculent-woolly, glabrate in age: leaves 2 to 3-pinnately parted into filiform-linear segments: heads few or several at the naked summit of the stem: involucre nearly $\frac{1}{2}$ inch broad: rays $\frac{3}{4}$ inch long, obscurely 3-lobed at summit, at first yellow, soon changing to cream-color or white: akenes 2 lines long, turning black. — Fl. Colorado, 77. S. W. Colorado, and W. New Mexico.

62. ACHILLEA,¹ Vaill. YARROW.

Herbs; with small and corymbosely cymose heads of white, yellow, or even rose-colored flowers; disk commonly yellow.

1. *A. Millefolium*, L. From villous-lanate to glabrate: stems simple, a foot or two high: leaves elongated and narrow in outline, sessile, bipinnately dissected into numerous small and linear to setaceous-subulate divisions: heads numerous, crowded in a fastigate cyme: involucre oblong; its bracts pale or sometimes fuscous-margined, or even wholly brownish: rays 4 or 5, about the length of the involucre, white, occasionally rose-color. — Common throughout the Northern hemisphere. Called either "Yarrow" or "Milfoil." Exceedingly variable.

¹ The Old-World genus *Anthemis* has several species naturalized in this country, one of which is an excessively common weed at the East, and becoming abundant within our range. It may be characterized as follows: —

A. Cotula, L. Stem rather low: herbage unpleasantly strong-scented: leaves finely 3-pinnately dissected: receptacle conical: rays mostly neutral and white or abortive: akenes 10-ribbed, rugose or tuberculate. — Known as "Mayweed" or "Dog-Fennel." *Maruta Cotula*, DC.

63. **MATRICARIA**,¹ Tourn., L.

Herbs, with finely once or thrice dissected leaves, and pedunculate heads, the rays white (or wanting) and the disk-flowers yellow.

1. **M. discoidea**, DC. Annual, somewhat aromatic, glabrous, a span to a foot high, very leafy: leaves 2 to 3-pinnately dissected into short and narrow linear lobes: heads all short-peduncled: bracts of the involucre broadly oval, white-scarious with greenish centre, hardly half the length of the well-developed greenish-yellow ovoid disk: akenes oblong, somewhat angled, with an obscure coroniform margin at summit, this occasionally produced into one or two conspicuous oblique auricles of coriaceous texture. — From W. California to Montana and far northward; becoming naturalized in the Atlantic States.

64. **TANACETUM**, Tourn. TANSY.

Strong-scented, alternate-leaved, yellow-flowered perennials. Ours are low, with stems rather slender and naked above, bearing rather small (2 lines broad) globular heads, and leaves simply or pedately 3 to 5-cleft.

1. **T. Nuttallii**, Torr. & Gray. Silvery-canescant, *loosely cespitose*, a span high: leaves short, mostly broad-cuneate with tapering base, *obtusely 3 to 5-lobed* at the broad summit; those of the flowering stems usually oblong or linear and entire: heads few, *somewhat paniculate or loosely clustered*, some of them slender-pedunculate: involucre very scarious. — Fl. ii. 415. Mountains of N. Wyoming.

2. **T. capitatum**, Torr. & Gray. Silvery-canescant, *densely cespitose*, a span high: leaves simply or pedately 3 to 5-parted into linear lobes, or some of them only 3-cleft at summit: *flowering stems scapiform* or 2 to 4-leaved: heads 10 or more, *sessile in a globose glomerule*. — Loc. cit. Mountains of N. Wyoming.

65. **ARTEMISIA**, Tourn., L. WORMWOOD. SAGE-BRUSH.

Herbs and low shrubs, bitter-aromatic; with alternate leaves and small paniculate heads, commonly nodding; the flowers yellow or whitish, usually sprinkled with resinous globules.

§ 1. *Heads heterogamous; the disk-flowers hermaphrodite but sterile, their ovary abortive, and style mostly entire: receptacle not hairy.* — DRACUNCULUS.

* *Akenes and flowers beset with long cobwebby and crisped hairs: spinescent undershrub.*

1. **A. spinescens**, Eaton. Stout and densely branched, rigid, 4 to 18 inches high, villous-tomentose: leaves small, pedately 5-parted and the divis-

¹ The following species of the Old-World genus *Chrysanthemum* has become extensively naturalized, its broad heads and conspicuous white rays making it very prominent. It may be characterized as follows:—

C. Leucanthemum, L. Glabrous, a foot or two high, simple or sparingly branched: cauline leaves spatulate, and the upper gradually narrower, becoming small and linear, pinnately dentate or incised, partly clasping at base; radical broader, petioled: head broad and flat: rays inch long: pappus none. — Known as "Ox-eye Daisy" or "Whiteweed." *Leucanthemum vulgare*, Lam.

ions 3-lobed; lobes spatulate: heads globose, racemosely glomerate on short and leafy branchlets, which persist as slender spines: bracts of the involucre 5 or 6, broadly obovate: female flowers 1 to 4; hermaphrodite-sterile flowers 4 to 8. — Bot. King Exp. 180. Whole desert region of Wyoming, Utah, Nevada, and Idaho.

* * *Akenes nearly glabrous: no spines.*

← *Leaves dissected.*

2. **A. Canadensis**, Michx. *A foot or two high: glabrous or mostly with at least the radical and sometimes all the leaves either sparsely or canescently silky-pubescent: leaves mostly 2-pinnately divided into narrow linear or almost filiform but plane lobes, of thickish texture: heads 1 or 2 lines long, very numerous in a compound oblong or pyramidal virgate panicle: involucre greenish, glabrous or rarely pubescent.* — Across the continent to the north, and extending southward in the Rocky Mountain region to New Mexico and Arizona.

3. **A. borealis**, Pall. *A span or two high from a stout caudex: stems simple: leaves silky-pubescent or silky-villous; radical and lower 1 to 2-ternately or pinnately divided into linear lobes; uppermost linear and entire or 3-parted: heads 2 lines broad, comparatively few, crowded in a narrow (rarely compound) spiciform thyrsus with leaves interspersed: involucre pilose or glabrate, pale-fuscescent to brownish.* — In the alpine region of Colorado, and far northward across the continent.

4. **A. pedatifida**, Nutt. *Cespitose, with a stout lignescent caudex, very dwarf, canescent throughout with a fine and close pubescence: leaves chiefly crowded in radical tufts and on the base of the (inch or two high) rather naked flowering stems, once or twice 3-parted into narrowly spatulate or nearly linear obtuse entire divisions: heads (hardly 2 lines broad) few, loosely spicately or racemosely disposed, canescently pubescent.* — Dry ground, in the mountains of Wyoming, Montana, and Idaho.

← ← *Leaves entire or 3-cleft or -parted: the whole plant or at least the base somewhat woody.*

5. **A. dracunculoides**, Pursh. *Glabrous: stems 2 to 4 feet high, either virgately or paniculately branched: leaves mostly entire, narrowly or sometimes more broadly linear, some 3-cleft: heads very numerous in a compound and crowded or open and diffuse panicle, many-flowered.* — On plains, from Saskatchewan to Texas, and westward across the continent.

6. **A. filifolia**, Torr. *Minutely canescent, even to the 3 to 6-flowered involucre, 1 to 3 feet high, with virgate rigid branches, very leafy: leaves all slender filiform, commonly 3-parted: the upper and those in axillary fascicles entire: heads very small, crowded in an elongated leafy panicle.* — Ann. Lyc. N. Y. ii. 211. Plains, from Nebraska to New Mexico and W. Texas.

§ 2. *Heads heterogamous: the disk-flowers hermaphrodite and fertile, with 2-cleft style.* — EUARTEMISIA. *Ours have the akenes obovoid or oblong and wholly destitute of pappus.*

* *Receptacle beset with long woolly hairs.*

7. **A. scopulorum**, Gray. *Herbaceous, a span or two high from a stout multicapital caudex, silky-canescenscent: stems simple, bearing 3 to 12 spicately or racemosely disposed hemispherical (rarely solitary) heads: radical and few lower*

cauline leaves pinnately 5 to 7-divided, and divisions 3-parted into spatulate-linear lobes; uppermost simply 3 to 5-parted or entire: involucre 2 lines broad, villous; its bracts brown-margined: corollas hirsute at summit.—Proc. Acad. Philad. 1863, 66. Alpine region, mountains of Colorado, Utah, and Wyoming.

8. **A. frigida**, Willd. Herbaceous from a suffrutescent base, silky-canescenscent and silvery, about a foot high: stems simple or branching, bearing numerous racemously disposed heads in an open panicle: leaves mainly twice ternately or quinately divided or parted into linear crowded lobes, and usually a pair of simple or 3-parted stipuliform divisions at base of the petiole: heads globular, barely 2 lines in diameter: involucre pale, canescent, its outer bracts narrow and herbaceous: corollas glabrous.—From Minnesota to Texas and westward to New Mexico, Nevada, and Idaho.

* * Receptacle not villous.

+ Annual and biennial.

9. **A. biennis**, Willd. Wholly glabrous, inodorous and nearly insipid: stem strict, 1 to 3 feet high, leafy to the top, bearing close glomerules of small heads in the axils from toward the base of the stem to the somewhat naked and spiciform summit: leaves 1 to 2-pinnately parted into lanceolate or broadly linear lacinate or incisely toothed lobes; or the uppermost small, sparingly pinnatifid and less toothed.—Open grounds from California and Oregon to Hudson Bay; also now spreading to the eastern seaboard farther south.

+ + Perennials.

+ + Heads many-flowered, broad (2 to 5 lines), several or numerous and loosely racemose or paniculate on mostly simple stems: alpine and subalpine, with dissected leaves and no cottony tomentum.

10. **A. Norvegica**, Fries. Rather stout, 5 to 25 inches high, from villous or pubescent to glabrate: leaves twice 3 to 7-parted into linear or lanceolate or more dilated segments: heads 4 or 5 lines broad, loosely racemose or racemose-paniculate, most of them long-peduncled: bracts of the involucre broadly brown-margined: corollas loosely pilose, rarely almost glabrous.—Mostly *A. arctica* of the Western Reports. From the high mountains of S. Colorado and S. California far northward.

11. **A. Parryi**, Gray. Rather stout, a foot or less high, wholly glabrous, leafy up to the loosely paniculate inflorescence of numerous short-peduncled heads: leaves 2 to 3-pinnately parted into mostly linear thickish lobes: involucre 2 or 3 lines broad, its bracts greenish with brownish margins and with the corollas glabrous.—Proc. Am. Acad. vii. 361. Mountains of Colorado, at Sangre de Cristo Pass.

+ + Heads comparatively small (1 to 3 lines high and broad), 12 to many-flowered, variously paniculate: flowers glabrous: herbs, mostly whitened (at least when young and on the lower surface of the leaves) with cottony tomentum.

= Tall, with numerous amply paniculate heads, strict stems, and undivided elongated-lanceolate or linear leaves, 3 to 7 inches long.

12. **A. serrata**, Nutt. Stems 6 to 9 feet high, very leafy: leaves green and glabrous above, white-tomentose beneath, lanceolate or uppermost linear, all serrate with sharp narrow teeth, pinnately veined, the earliest sometimes pin-

nately incised: heads rather few-flowered, less than 2 lines long, greenish, *hardly pubescent*. — Prairies, the Dakotas to Illinois.

13. **A. longifolia**, Nutt. *Stem 2 to 5 feet high: leaves entire, at first tomentulose, but usually glabrate above, white-tomentose beneath, linear or linear-lanceolate (1 to 5 lines wide): heads usually canescent, 2 or 3 lines long.* — Minnesota and Nebraska to Montana.

== = *Not so tall: leaves more or less cleft or divided, or when entire comparatively short, not filiform nor narrowly linear.*

a. *Involucre from canescent to woolly, 12 to 20-flowered.*

14. **A. Ludoviciana**, Nutt. *A foot to a yard high, simple or with virgate branches, sometimes paniculate, completely and somewhat flocculently white-tomentose, or upper face of leaves sometimes early glabrate and green: leaves from linear-lanceolate to oblong, sometimes nearly all undivided and entire; commonly the lower with a few coarse teeth or incisions, or 2 to 3-cleft, or irregularly 3 to 5-parted into lanceolate or linear entire lobes: heads glomerately paniculate, not over 2 lines long: involucre woolly-tomentose.* — Including also var. *gnaphalodes*, Torr. & Gray. Across the continent from the west to Michigan and Illinois.

15. **A. Mexicana**, Willd. *Paniculately branched, 2 to 4 feet high, less tomentose: leaves narrow-lanceolate to linear, commonly attenuate, some 3 to 5-cleft or parted; radical cuneate, incisely pinnatifid or trifid: heads very numerous in an ample loose panicle, many pedicellate, 1 to 2 lines long: involucre arachnoid-canescens or glabrate, largely scarious.* — *A. Ludoviciana*, var. *Mexicana*, Gray. Dry plains, from S. Nevada, S. Colorado, and Arizona to Texas and Arkansas.

b. *Involucre glabrous, 20 to 40-flowered.*

16. **A. franserioides**, Greene. *Glabrous throughout, or minutely and obscurely puberulent: stem rather stout, 2 or 3 feet high: leaves comparatively ample, green above, pale and barely cinereous beneath; lower bipinnately and upper simply pinnately parted into lanceolate-oblong obtuse entire or 2 to 3-cleft divisions and lobes: heads numerous, loosely racemose on the branches of the leafy elongated panicle, 2 or 3 lines broad.* — Bull. Torr. Club, x. 42. Mountains of S. Colorado, New Mexico, and Arizona.

17. **A. discolor**, Dougl. *A foot high, mostly slender, glabrous or glabrate except the lower face of the leaves: these white with close cottony tomentum, 1 to 2-pinnately parted into narrow linear or lanceolate entire or sparingly lacinate divisions and lobes: heads glomerate in an interrupted spiciform or virgate panicle, 1 or 2 lines high.* — Mountains of British Columbia and Montana to Utah, Nevada, and California.

Var. *incompta*, Gray. *Stouter, with coarser or less dissected leaves, having mostly broader lobes, or the upper entire.* — Synopt. Fl. i. 373. *A. incompta*, Nutt. Mountains from Wyoming and Montana to California and Washington.

== = *Rather low: leaf-divisions narrowly linear or filiform: heads 15 to 20-flowered, in a narrow thyrsoid or spiciform panicle.*

18. **A. Wrightii**, Gray. *Cinereous or canescent, or radical shoots sometimes white-tomentose, 10 to 20 inches high, very leafy up to the panicle:*

leaves pinnately 5 to 7-parted into very narrow linear and by revolution filiform entire divisions: involucre minutely cinereous-canescant, becoming glabrate. — Proc. Am. Acad. xix. 48. Plains of Southern Colorado and New Mexico.

++ ++ ++ *Heads small and narrow, very few-flowered: flowers glabrous: stems woody at base.*

19. **A. Bigelovii**, Gray. Silvery-canescant throughout, a foot high: leaves from oblong- to linear-cuneate, mostly 3-toothed at the truncate apex, about $\frac{1}{2}$ inch long: heads very numerous and crowded in the oblong or virgate thyrsiform panicle, tomentose-canescant, containing only one or two hermaphrodite and as many female flowers, all fertile. — Pacif. R. Rep. iv. 110. Rocky banks, Colorado, on the Upper Canadian and Arkansas.

§ 3. *Heads homogamous, the flowers all hermaphrodite and fertile: receptacle not hairy.* — SERIPHIDIUM. *Ours are the true "Sage-brushes," being rather shrubby, canescant or silvery with a fine or close tomentum, and heads not nodding.*

20. **A. arbuscula**, Nutt. Dwarf, a span or rarely a foot high, with a stout base and slender flowering branches: leaves short, cuneate or flabelliform, 3-lobed or parted, with the lobes obovate to spatulate-linear, sometimes again 2-lobed; those subtending the heads usually entire and narrow: panicle strict and comparatively simple and naked, often spiciform and reduced to few rather scattered sessile heads: involucre 5 to 9-flowered. — High mountains and elevated plains, from Wyoming and Utah to Idaho and California.

21. **A. tridentata**, Nutt. Larger, 1 to 6 (or even 12) feet high, much branched: leaves cuneate, obtusely 3-toothed or 3-lobed, or even 4 to 7-toothed, at the truncate summit, uppermost cuneate-linear: heads densely paniculate: involucre 5 to 8-flowered, its outer or accessory tomentose-canescant bracts short and obovate. — From Montana to Colorado and westward. Immensely abundant; the characteristic "Sage-brush," or "Sage-wood."

22. **A. trifida**, Nutt. A foot or two high, sometimes lower, much branched: leaves 3-cleft and 3-parted; the lobes and the entire upper leaves narrowly linear or slightly spatulate-dilated: heads numerous in the contracted leafy panicle, or spicately disposed on its branches: involucre 3 to 5-flowered, rarely 6 to 9-flowered, its outer or accessory bracts oblong to short-linear or lanceolate. — Wyoming and Utah to Washington and California.

23. **A. cana**, Pursh. A foot or two high, freely branched, silvery canescant: leaves lanceolate-linear or narrower, somewhat tapering to both ends, an inch or two long, entire, rarely with 2 or 3 acute teeth or lobes, margins not revolute: heads glomerate in a leafy contracted panicle, 6 to 9-flowered, rarely 5-flowered, usually with one or two linear subulate accessory bracts. — Plains, Saskatchewan to Montana, the Dakotas, and Colorado.

66. PETASITES, TOWN. BUTTER-BUR. SWEET COLTSFOOT.

Perennial herbs, with thickish and creeping rootstocks, sending up scapiform simple flowering stems and ample radical leaves on strong petioles, cottony-tomentose or glabrate; the flowers whitish or purplish.

1. **P. sagittata**, Gray. Leaves from deltoid-oblong to reniform-hastate, from acute to rounded-obtuse, repand-dentate, very white-tomentose beneath, when full grown 7 to 10 inches long: heads short-racemose becoming corymbose. — Bot. Calif. i. 407. Wet ground, in the mountains of Colorado and northward; across the continent in northern latitudes.

67. HAPLOESTHES, Gray.

The name refers to the few (4 or 5) bracts of the involucre.

1. **H. Greggii**, Gray. Somewhat fleshy, herbaceous or suffrutescent, a foot or two high, fastigiate branched, glabrous, leafy up to the loose cymes of a few slender-pedunculate naked heads: leaves all opposite, very narrowly linear or filiform, entire; the lower connate at base: heads 2 or 3 lines high: flowers yellow: ligules 1 or 2 lines long. — Pl. Fendl. 109. Saline soil, S. E. Colorado to W. Texas.

68. TETRADYMIA, DC.

Low and rigid shrubs, sometimes spinescent, canescently tomentose; with alternate and sometimes fascicled narrow and entire leaves, cymose or clustered heads of yellow flowers, and a copious white pappus.

* *Involucre 4-flowered, of 4 or 5 bracts: pappus extremely copious: akenes either very villous or glabrous: undershrubs, a foot or two high.*

1. **T. canescens**, DC. *Permanently canescent with a dense close tomentum, unarmed, fastigiate branched: leaves from narrowly linear to spatulate-lanceolate, an inch or less long: heads $\frac{1}{2}$ to $\frac{3}{4}$ inch long, most of them short-pedunculate.* — Hills and plains, N. Wyoming and British Columbia to New Mexico, Arizona, and California.

Var. **inermis**, Gray. A form with shorter and crowded branches, shorter leaves more inclined to spatulate and lanceolate, and smaller heads. — Bot. Calif. i. 408. The commonest form.

2. **T. glabrata**, Gray. *Whitened with looser at length deciduous tomentum, unarmed: branches more slender, spreading: leaves at length naked and green, primary ones slender-subulate, cuspidate, on young shoots appressed, half-inch long; those of fascicles in their axils spatulate-linear, fleshy, pointless: heads mostly short-pedunculate: involucre often glabrate.* — Pacif. R. Rep. ii. 122. From Colorado and Utah to California and Oregon.

3. **T. Nuttallii**, Torr. & Gray. *Pubescence and foliage of T. canescens, var. inermis, bearing rigid divergent spines in place of primary leaves: leaves of the axillary fascicles mostly spatulate: heads more glomerate.* — Fl. ii. 447. Utah and Wyoming.

* * *Involucre 5 to 9-flowered, of 5 or 6 broader bracts: proper pappus less copious, reduced nearly or quite to a single series of bristles, which are covered by a false pappus of extremely long very soft and white woolly hairs which densely clothe the akene: shrubs 2 to 4 feet high, at least the branches densely white-tomentose.*

4. **T. spinosa**, Hook. & Arn. *Branches divaricate, rigid, bearing rigid and straight or recurved spines in place of primary leaves: secondary leaves*

fascicled in the axils, small, fleshy, linear-clavate, glabrous or glabrate: heads scattered, pedunculate, fully $\frac{1}{2}$ inch long: pappus of comparatively rigid capillary bristles, a little surpassing the wool of the akene.—From S. Wyoming to Arizona, S. E. California, and E. Oregon.

69. ARNICA, L.

Perennial herbs; with erect stems, simple or branching, opposite leaves, and comparatively large long-pedunculate heads of yellow flowers.

* *Radical leaves cordate at base, on slender or sometimes winged petioles; cauline all opposite, in 1 to 3 pairs, dentate or denticulate.*

1. **A. cordifolia**, Hook. A foot or two, or when alpine a span or two high, pubescent, or the stems hirsute and peduncles villous: *lower cauline as well as radical leaves long-petioled, deeply cordate*, yet sometimes only ovate; upper cauline small, sessile: heads few, in smaller plants solitary: involucre $\frac{3}{8}$ inch long, pubescent or villous: rays commonly an inch long: *akenes more or less hirsute*.—From the mountains of Colorado to those of California and British Columbia.

Var. **eradiata**, Gray. An ambiguous form; with smaller and rayless heads, and oblong-ovate at most subcordate leaves.—Synopt. Fl. i. 381. Montana and E. Oregon.

2. **A. latifolia**, Bong. Minutely pubescent or commonly glabrous, with *smaller heads than the preceding: only radical leaves cordate or subcordate and petioled; cauline 2 or 3 pairs, equal, ovate or oval, usually sharply dentate, closely sessile by a broad base, or lowest with contracted base: akenes commonly glabrate or glabrous*.—Pine woods, mountains of Colorado and Utah to Oregon, British Columbia, and Alaska.

* * *No cordate leaves; radical leaves petioled, tapering or abrupt at base.*

+ *Leafy to the top: cauline leaves seldom less than 4 pairs, and the upper not conspicuously diminished.*

3. **A. Chamissonis**, Less. *From tomentose or villous-pubescent to nearly glabrous: leaves oblong or oblong-lanceolate, denticulate or dentate, acute or obtuse; lowest tapering into a margined petiole, upper broad at base and somewhat clasping: akenes hirsute-pubescent*.—Including *A. mollis*, Hook.; also *A. latifolia* in part, of the Western Reports. Mountains of Colorado and Utah to those of California and far northward.

4. **A. longifolia**, Eaton. *Many-stemmed in a tuft, minutely puberulent: cauline leaves elongated-lanceolate, tapering to both ends, entire or denticulate, somewhat nervose, 3 to 6 inches long, lower with narrowed bases connate-vaginate: heads corymbosely disposed, short-peduncled: akenes minutely glandular, not hairy*.—Bot. King Exp. 186. Wasatch Mountains and westward.

5. **A. foliosa**, Nutt. *Tomentose-pubescent, strict: leaves lanceolate, denticulate, nervose; upper partly clasping by narrowish base, lower with tapering bases connate: heads short-peduncled, rarely solitary: akenes hirsute-pubescent or glabrate*.—*A. Chamissonis* of the Western Reports, in part. From the Saskatchewan to Oregon and southward along the mountains to N. California and Colorado.

+ + *Less leafy: cauline leaves 1 or 2 (rarely 3) pairs, and the upper mostly small.*

6. **A. Parryi**, Gray. A foot or less high, slender, simple, somewhat hirsutely pubescent and above glandular: *leaves membranaceous*, commonly denticulate; radical oval to ovate-oblong, 1 to 3 inches long, *abruptly or cuneately contracted at base into a short margined petiole*; cauline remote: involucre hirsute and glandular, $\frac{1}{2}$ inch or less high: *heads rayless*, occasionally some outermost corollas ampliate: *akenes glabrous* or with a few sparse hairs.—Am. Nat. viii. 213. *A. angustifolia*, var. *eradiata*, Gray. Mountains from Colorado to Wyoming and westward.

7. **A. alpina**, Olin. A span to 18 inches high, pubescent, hirsute, or at summit villous, strict, simple and monocephalous, occasionally 3-cephalous: *leaves thickish, from narrowly oblong to lanceolate, or the radical oblong-spatulate* and small uppermost linear, entire or denticulate, 3-nerved; bases of the cauline hardly at all connate: *heads conspicuously radiate*: *akenes hirsute-pubescent*, rarely glabrate.—*A. angustifolia*, Vahl. In the mountains of Colorado and California; across the continent in high latitudes.

70. SENECIO, Tourn. GROUNDSEL.

A very large genus; with alternate leaves and heads of yellow flowers. Ours all belong to the section of perennials having the pubescence (if any) of a tomentose or floccose kind and never viscid nor hirsute.

* *Heads an inch or distinctly over $\frac{1}{2}$ inch high, very many-flowered.*

+ *Heads radiate.*

+ + *Alpine species.*

1. **S. Soldanella**, Gray. Apparently glabrous from the first, a span high, somewhat succulent: leaves mostly radical and long-petioled, *from round-reniform to spatulate-obovate, denticulate or entire*; cauline one or two or none: head solitary, erect, *two thirds to nearly a full inch high*: involucre linear-lanceolate and a very few calyculate ones: rays 6 to 10, *oblong, a quarter-inch long*.—Proc. Acad. Philad. 1863, 67. High alpine, in the mountains of Colorado.

2. **S. amplexans**, Gray. Lightly floccose-woolly at first, soon glabrate, a foot or so high, *few to several-leaved*, terminated by one or two long-pedunculate nodding heads: leaves thinner than in the foregoing, *from denticulate to conspicuously and sharply dentate*; radical obovate to spatulate, tapering into a winged petiole: cauline as large or larger, oblong or narrower, half-clasping or more, the upper by a broad base: involucre over half-inch high, of linear bracts and a few loose calyculate ones: rays linear, *inch long or more*, acute or acutely 2 to 3-toothed at tip.—Am. Jour. Sci. II. xxxiii. 240. Alpine and subalpine region, mountains of Colorado.

Var. **taraxacoides**, Gray. Only a span or two high, with fewer and smaller cauline leaves; these and the radical commonly spatulate and with tapering base, not rarely laciniately subpinnatifid: head smaller, even down to half-inch, and with rays of only the same length.—Proc. Acad. Philad. 1863, 67. High alpine, in the mountains of Colorado and Nevada.

++ ++ *Not alpine, with leafy stems a foot or so high.*

3. **S. megacephalus**, Nutt. About a foot high, loosely floccose-woolly, tardily glabrate, leafy: leaves entire, lanceolate, or the radical spatulate-lanceolate and tapering into a petiole, and uppermost cauline attenuate, thickish: heads 1 to 3, short-peduncled, 8 lines to an inch high: involucre calyculate by some very loose and subulate elongated accessory bracts: rays over $\frac{1}{2}$ inch long. — From the mountains of Idaho to the Rocky Mountains near the British boundary.

+ + *Heads rayless, nodding: some sparse crisped hairs in place of tomentum.*

4. **S. Bigelovii**, Gray. Robust, 2 or 3 feet high, leafy up to near the racemiform or simply paniculate inflorescence, at length glabrate: leaves from elongated-oblong to lanceolate, denticulate or dentate, acute or acuminate; radical and lower cauline 3 to 6 inches long, abrupt at base and naked-petioled, or tapering into a winged petiole or partly clasping base; upper lanceolate with partly clasping base: heads in small plants few or solitary. — Pacif. R. Rep. iv. 111. Includes also var. *Hallii*, Gray. Mountains of Colorado, New Mexico, and Arizona.

* * *Heads middle-sized or small, half-inch or less,*

+ *Nodding, rayless: leafy-stemmed.*

5. **S. cernuus**, Gray. Quite glabrous, 2 or 3 feet high: leaves lanceolate or the larger oblong-lanceolate, entire, denticulate, rarely with a few scattered coarser teeth, all tapering at base into a barely margined petiole, or upper into a narrowed not clasping base: heads (4 to almost 6 lines long) several or numerous in the panicle, most of them decidedly nodding: flowers pale yellow. — Am. Jour. Sci. II. xxxiii. 10. Mountains of Colorado, wholly below the alpine region.

+ + *Heads erect, mostly radiate.*

+ *Stems numerously and nearly equally leafy to the top: leaves from entire to lacinate-dentate, never divided or dissected, nor narrowly linear: glabrous or very early glabrate.*

= *Low, alpine: heads subsolitary, radiate.*

6. **S. Fremonti**, Torr. & Gray. Many-stemmed from a thickish caudex, a span to a foot high: leaves thickish, from rounded-obovate or spatulate to oblong, 1 to 2 inches long, obtuse, obtusely or acutely dentate, sometimes even pinnatifid-dentate; lower abruptly contracted into a winged petiole; uppermost sessile by broadish base: heads $\frac{1}{2}$ inch high: rays 3 to 5 inches long. — Fl. ii. 445. Alpine regions, from the British boundary to S. Colorado, Utah, and California.

Var. **occidentalis**, Gray. More slender, with rounder leaves and heads longer-peduncled; in high alpine stations becoming very dwarf, and flowering almost from the ground. — Bot. Calif. i. 618. Mountains of N. Wyoming, Montana, and California.

= = *Rather low, with numerous cymosely paniculate and small heads, always rayless.*

7. **S. rapifolius**, Nutt. About a foot high: leaves ovate or oblong, throughout very sharply and unequally dentate, rather fleshy; radical tapering

into a petiole, cauline mostly clasping by a broad subcordate base: heads 3 lines high, about 15-flowered: involueral bracts 8 to 10, narrowly oblong.— Rocky Mountains, Wyoming, about the sources of the Platte.

= = = *Tall, with corymbosely cymose and radiate heads: leaves nearly membranaceous.*

8. **S. triangularis**, Hook. Rather stout: stem simple, 2 to 5 feet high, bearing several or somewhat numerous heads in a corymbiform open cyme: leaves all more or less petioled and thickly dentate with more or less salient teeth, deltoid-lanceolate, or the lower triangular-hastate or deltoid-cordate, and uppermost lanceolate with cuneate base: rays 6 to 12.— From the Saskatchewan to Washington and southward in the mountains to Colorado and California.

9. **S. serra**, Hook. Strict, 2 to 4 feet high, very leafy, sometimes simple and bearing rather few heads, commonly branching at summit, then bearing numerous corymbosely paniculate smaller heads: leaves 4 to 6 inches long, all lanceolate and tapering to both ends, sessile by a narrow base, or the lowest oblong-spatulate and tapering into a short petiole, usually with the whole margin thickly serrate or serrulate with very acute salient teeth: rays 5 to 8.— In the Western Reports principally under the name of *S. Andinus*. Mountains of Colorado to Idaho and Wyoming.

Var. **integriusculus**, Gray. Heads smaller, 3 or 4 lines high, and narrower, fewer-flowered: leaves minutely serrate or denticulate, or the upper entire, sometimes all entire or nearly so, generally shorter and smaller, or broader and not acuminate.— Synopt. Fl. i. 387. *S. Andinus*, Nutt. From Wyoming to Oregon and California.

++ ++ *Stem not numerously but somewhat equably leafy up to the inflorescence: leaves all entire or denticulate: involucre fleshy-thickened.*

10. **S. crassulus**, Gray. A foot or less high, glabrous: stem 5 to 7-leaved, bearing 3 to 8 pedunculate rather large and thick heads: leaves oblong-lanceolate, apiculate-acute, 2 to 5 inches long; radical and lowest cauline spatulate or obovate-oblong, narrowed into a short winged petiole; upper sessile by partly clasping or decurrent base: involucre 40 to 50-flowered, of 12 fleshy-thickened but thin-edged bracts, the base also thickened, the whole becoming conical and multangular in fruit: rays about 8.— Proc. Am. Acad. xix. 54. *S. integerrimus*, Gray, in part; *S. lugens*, var. *Hookeri*, Eaton, in part. Subalpine, mountains of Colorado to Utah and Wyoming.

++ ++ ++ *Stems either few-leaved or with the upper leaves reduced in size; the inflorescence therefore naked: none with narrow linear leaves.*

= *Tall and simple-stemmed, with a fibrous cluster of roots: leaves fleshy coriaceous, all entire or barely denticulate.*

11. **S. hydrophilus**, Nutt. Very glabrous or smooth: stem robust, 2 to 4 feet high, strict: leaves lanceolate; radical oblanceolate and stout-petioled, sometimes a foot long; upper cauline sessile or partly clasping: heads numerous in a branching cyme: bracts 8 to 12: disk-flowers 15 to 30; rays 3 to 6 and small, or none.— In water or very wet ground, from Colorado and California to Montana and British Columbia.

= = *Plants mostly in clumps or tufts, or from tufted or creeping rootstocks.*

- a. *Stems mostly robust, generally a foot to 3 or 5 feet high, bearing numerous heads in a cyme: rays 8 to 12, conspicuous: leaves from entire to dentate, none really cordate nor with permanent tomentum. None truly alpine.*

12. **S. integerrimus**, Nutt. *Leaves oblong-lanceolate, or the radical elongated-oblong, quite entire or denticulate; upper ones reduced and bract-like, attenuate-subulate from a dilated base: heads several, umbellately cymose, commonly $\frac{1}{2}$ inch high: involueral bracts narrow, acute or acuminate.* — The Dakotas to Wyoming and the Saskatchewan.

13. **S. lugens**, Richards. *Lightly floccose-woolly when young, in the typical form early glabrate and bright green: stem 6 inches to 2 feet high, few- and small-leaved and naked above, terminated by a cyme of several or rather numerous heads: radical and lower cauline leaves spatulate, varying to oval or oblong, either gradually or abruptly contracted at base into a winged or margined short petiole, usually repand- or callous-denticulate; upper cauline lanceolate or reduced and bract-like: bracts of the involucre lanceolate, with obtuse or acutish commonly blackish tips: rays 10 or 12, conspicuous.* — Includes var. *Hookeri* and var. *Parryi*. Through the whole Rocky Mountains to New Mexico and westward to California.

Var. **foliosus**, Gray. *Floccose wool usually persistent up to flowering, and vestiges remaining to near maturity: stem seldom over a foot high, stouter, more leafy to near the inflorescence: leaves comparatively large, oblong to broadly lanceolate: heads often very numerous and crowded in the corymbiform cyme, then narrower: tips of involueral bracts conspicuously blackish.* — Bot. Calif. i. 413. *S. lugens*, var. *exaltatus*, Eaton. Mountains of Colorado and Utah.

Var. **exaltatus**, Gray. *Lightly floccose when young, and not rarely with looser and more persistent scattered hairs: stem stout, 1 to 3 or even 4 or 5 feet high: leaves thickish; radical longer-petioled, from spatulate-lanceolate to obovate or ovate, the broader ones abrupt and sometimes even subcordate at base; cauline occasionally laciniate-dentate: heads mostly numerous in the cyme.* — Loc. cit. *S. exaltatus*, Nutt. Wet ground, British Columbia and Idaho to California, extending within the western limits of our range.

- b. *Stems low, only 2 to 6 inches high, scapiform: leaves clustered on the rootstock or caudex, entire or crenate; those of the scape reduced to mere bracts. Chiefly alpine or subalpine.*

1. *Leaves thick and coriaceous, tapering into a petiole, crowded on the multicapital caudex.*

14. **S. werneriaefolius**, Gray. *Woolly and canescent, tardily glabrate: leaves quite entire, erect or ascending, from spatulate-linear (2 or 3 inches long, including the petiole-like base) to elongated-oblong and short-petioled, the margins sometimes revolute: scape a span high, rather stout, bearing 2 to 8 heads; these 4 or 5 lines high: rays 10 or 12, oblong, 2 lines long, rarely few or wanting* — Proc. Am. Acad. xix. 54. *S. aureus*, var. *werneriaefolius*, Gray. Mountains of Colorado, alpine.

15. **S. petræus**, Klatt. *Glabrous or early glabrate: leaves from orbicular-obovate or oval ($\frac{1}{4}$ to $\frac{1}{2}$ in. ch. long) to cuneate-oblong, entire or 3 to 7-crenate-toothed at the broad summit, abruptly petioled: scapes 1 to 3 inches high, bearing solitary or several clustered heads; these 4 or 5 lines high: rays 6 to 10, golden yellow, 3 lines long.* — *S. aureus*, var. *alpinus*, Gray. Alpine region of the mountains of Colorado, Utah, and California.

2. *Leaves round-cordate, crenate, purple-tinged beneath, slender-petioled, more or less clustered at the base of the scape: plants very glabrous.*

16. **S. renifolius**, Porter. Two inches high from filiform creeping rootstocks: leaves thickish, resembling those of *Ranunculus Cymbalaria*, rounded-subcordate or reniform, only about $\frac{1}{2}$ inch wide, coarsely 5 to 7-crenate: scape or peduncle little surpassing the leaves, bearing a solitary comparatively large ($\frac{1}{2}$ inch long) head: rays about 8, oblong, 4 lines long. — Fl. Colorad. 83. High alpine region on Whitehouse Mountain, in Central Colorado, at 13,000 feet, *J. M. Coulter*.

c. *Stems a foot or two high or less, bearing some leaves and corymbosely cymose heads. Mostly not alpine: usually some floccose tomentum.*

1. *Leaves from entire or serrate to pinnatifid in the same species, none pinnately divided: rays sometimes wanting.*

17. **S. canus**, Hook. *Permanently tomentose-canescens, or at length flocculent, but rarely at all glabrate: stems from a span to 2 feet high: leaves sometimes all undivided or even entire, the radical and lower from spatulate to oblong, $\frac{1}{2}$ to $1\frac{1}{2}$ inches in length, slender-petioled, sometimes laciniate-toothed or pinnatifid: akenes very glabrous.* — From the Dakotas to Colorado and west to California and British Columbia.

18. **S. aureus**, L. *Very early glabrate, usually quite free from wool at flowering and a foot or two high from small rootstocks: radical leaves mostly rounded and undivided, and cauline lanceolate and pinnatifid or laciniate: most polymorphous species, of which the typical form is bright green, 1 to 3 feet high: leaves thin; principal radical ones roundish, cordate or truncate at base, crenate-dentate, 1 to 3 inches in diameter, on long slender petioles; lower cauline similar, with 2 or 3 lobes on the petiole, or lyrate divided or lobed; others more laciniate-pinnatifid and lobes often incised; uppermost sparse and small, with closely sessile or auriculate-dilated incised base: akenes quite glabrous.* — Very abundant, across the continent. The following are the principal forms within our range.

Var. **Balsamitæ**, Torr. & Gray. Less glabrate, not rarely holding more or less wool until fruiting: depauperate stems a span or two, larger fully 2 feet high: principal or earliest radical leaves oblong, sometimes oval, commonly verging to lanceolate, inch or two long, serrate, contracted into slender petioles: the succeeding lyrate pinnatifid: heads usually rather small and numerous: akenes almost always hispidulous-pubescent on the angles. — From Texas to Colorado and British Columbia and eastward to Canada.

Var. **compactus**, Gray. A span or two high, in close tufts, rather rigid, when young whitened with fine tomentum, glabrate in age: radical leaves oblanceolate or attenuate-spatulate, entire or 3-toothed at apex, or pinnatifid-dentate, an inch or more long, thick and firm at maturity; cauline lanceolate or

linear, entire or pinnatifid: heads rather numerous and crowded in the cyme, rather small: ovaries *papillose-hispidulous* on the angles — Synopt. Fl. i. 391. From Colorado to N. W. Texas; mostly in saline soil.

Var. **borealis**, Torr & Gray. A foot down to a span high, at summit bearing either numerous or few heads; these not rarely rayless: leaves thickish; *radical from roundish with abrupt or even truncate base to cuneate-obovate and cuneate-spatulate*, $\frac{1}{2}$ to 1 inch long, slender-petioled; cauline seldom much pinnatifid: *akenes glabrous*. — Mountains of Colorado, California, and northward, where it extends across the continent.

Var. **croceus**, Gray. A span to a foot or two high, glabrous or early glabrate: leaves somewhat succulent; *radical oblong to roundish, sometimes lyrate*; cauline very various: heads usually numerous in the cyme: *flowers saffron-colored or orange*, at least the rays, or these sometimes wanting. — Proc. Acad. Philad. 1863, 68. Mountains of Colorado to Montana, Nevada, and California.

Var. **subnudus**, Gray. Wholly glabrous or glabrate, slender, *a span or two high, bearing 2 or 3 small cauline leaves and a solitary head*, or not rarely a pair: radical leaves few, spatulate or obovate, sometimes roundish, half-inch or less long, occasionally lyrate; cauline incised or sparingly pinnatifid: rays conspicuous. — Synopt. Fl. i. 391. Wyoming to British Columbia and California.

19. **S. Fendleri**, Gray. *Very canescent with floccose wool*, in age tardily glabrate: stems rather stout, 5 to 15 inches high, leafy, the larger plants branching: *leaves oblong-lanceolate or narrower*; *radical sometimes almost entire*, more commonly like the *cauline sinuately pectinate-pinnatifid* or even pinnately parted, the short oblong divisions incisely 2 to 4-lobed: *akenes glabrous*. — Pl. Fendl. 108. Mountains of Colorado and New Mexico.

2. *Leaves mostly once pinnately divided or parted and again lobed or incised.*

20. **S. eremophilus**, Richards. Stems freely branching, leafy up to the inflorescence: leaves mostly oblong in outline, laciniately-pinnatifid or pinnately parted, the lobes usually incised or dentate: heads in corymbiform cymes, short-peduncled: bracts commonly purple-tipped: rays 7 to 9: akenes minutely papillose or glabrous. — In the Rocky Mountains, from New Mexico to the Mackenzie River.

++ ++ ++ ++ *Stems leafy, numerously or somewhat equably so up to the top: leaves all pinnately lobed or parted or entire, their divisions (or the whole leaf) linear to filiform.*

21. **S. Douglasii**, DC. Lignescant and sometimes decidedly shrubby at base, many-stemmed, a foot or two or even 5 or 6 feet high, either white-tomentose or glabrate and green: leaves thickish, sometimes all entire and elongated-linear, more commonly pinnately parted into 3 to 7 linear or nearly filiform entire divisions: heads several or numerous and cymose, from $\frac{1}{2}$ to $\frac{1}{2}$ inch high: rays 8 to 18: akenes canescent with a fine strigulose pubescence. — *S. longilobus*, Benth.; *S. filifolius*, Nutt. Plains and hills, Nebraska to Texas and westward to California.

71. **CNICUS**,¹ Tourn., L., partly. PLUMED THISTLE.

Stout herbs; with sessile leaves, commonly with prickly teeth and tips, and large or middle-sized heads: the flowers red or purple, rarely white or yellowish. — *Cirsium*, DC.

* *Bracts of the ovoid or hemispherical involucre appressed-imbricated and the outer successively shorter, all with loose and dilated fimbriate or lacerate white-scarious tips.*

1: **C. Americanus**, Gray. A foot or two high, branching above: branches bearing solitary or scattered naked heads: leaves white-tomentose beneath, lanceolate or broader, sinuately pinnatifid, or some merely dentate, others pinnately parted, weakly prickly: *heads erect*, an inch high: principal bracts of the involucre naked-edged or merely fimbriate-ciliate below, and the dilated scarious apex as broad as long, fimbriate-lacerate, tipped with a barely exerted cusp; innermost with lanceolate nearly entire scarious tips: flowers ochroleucous: stronger pappus-bristles dilated-clavellate at tip. — Proc. Am. Acad. xix. 56. Lower mountains of Colorado and New Mexico to California.

* * *Bracts of the involucre mostly loose, not appressed-imbricated nor rigid, tapering gradually from a narrow base to a slender-prickly or muticous apex: outer not very much shorter than the inner, wholly destitute of dorsal glandular ridge or spot: pappus-bristles not clavellate-tipped.*

2. **C. Parryi**, Gray. Green, lightly arachnoid and villous when young, 2 feet or so high: *leaves lanceolate, sinuate-dentate, not decurrent, moderately prickly*: heads several and spicately glomerate or more racemosely paniculate, more or less bracteo-se leafy at base: *accessory and outer proper bracts* or some of them *pectinately fimbriate-ciliate down the sides, innermost with more or less dilated or margined mostly lacerate-fimbriate tips*: corollas pale yellow; the lobes longer than the throat: pappus of fine soft bristles, none of them obviously clavellate. — Proc. Am. Acad. x. 47. Mountains of Colorado and Utah.

3. **C. eriocephalus**, Gray. Loosely arachnoid-woolly and partly glabrate, very leafy: *leaves pinnatifid into very numerous and crowded and numerous prickly short lobes, the base decurrent on the stem into prickly wings*: heads several, sessile, and crowded in a leaf-subtended at first nodding glomerule; *the subtending leaves and the involucreal bracts densely long-woolly, all very slender-prickly*: corollas light yellow or yellowish — Alpine region of the Rocky mountains of Colorado.

* * * *Bracts of the involucre moderately unequal or the lower not rarely about equalling the upper, more rigid and imbricated at base, but most of them with*

¹ The naturalized genus *Arctium*, "Burdock," may be known by the hooked tips of its involucreal bracts forming a bur, otherwise unarmed; large mostly cordate leaves; and rather small heads of pink or purplish flowers. The species is

A. lappa, L., and is 3 to 5 feet high, with cymose heads, leaves green and glabrous above but whitish with cottony down beneath, and in the larger forms with the bur an inch or more in diameter, its bracts all spreading and glabrous.

more or less herbaceous spinescent-tipped spreading upper portion, and no glandular dorsal ridge.

4. **C. Eatonii**, Gray. A foot or so high, mostly simple, loosely arachnoid-woolly or glabrate: leaves pinnatifid or pinnately parted into short lobes, mostly very prickly, either green and glabrate, or remaining whitish-woolly beneath: heads an inch high, few or several and sessile in a terminal cluster: involucre from arachnoid-ciliate to glabrate or apparently glabrous; its principal bracts erect, with broadish appressed base, abruptly attenuate into the subulate-acerose slightly herbaceous spinescent portion, outermost little shorter than the inner: corolla whitish. — Proc. Am. Acad. xix. 56. *Cirsium foliosum* and *C. Drummondii* in part, of the Western Reports. Mountains of Colorado, Utah, and Nevada.

5. **C. Neo-Mexicanus**, Gray. Stout, 2 to 4 feet high; herbage and commonly squarrose involucre copiously white-woolly: leaves from sinuate-dentate to pinnatifid, not very prickly: heads solitary, terminating the stem or branches, often 2 inches high and broad: principal bracts of the involucre with spinescent rigid tips $\frac{1}{2}$ to 1 inch long: corolla from white to pale-purple. — Proc. Am. Acad. x. 45. Plains of S. Colorado, New Mexico, and Arizona.

* * * * Bracts of the involucre regularly and chiefly appressed-imbricated in numerous ranks; the outer successively shorter, not herbaceous-tipped or appendaged.

← Flowers from rose-purple to white: involucre glabrous or early glabrate, the light arachnoid wool caducous; its bracts coriaceous, not at all glandular on the back, outer tipped with a short weak prickle or cusp, innermost wholly unarmed.

6. **C. Drummondii**, Gray. Green and somewhat villous-pubescent, or when young lightly arachnoid-woolly, either stemless and bearing sessile heads in a cluster on the crown, or caulescent and even 2 or 3 feet high, with solitary or several loosely disposed heads: leaves from sinuate or almost entire to pinnately parted, moderately prickly: larger heads fully 2 inches high: involucre bracts weak-prickly pointed, innermost with more scarious and sometimes obviously dilated and erose-fimbriate tips: corollas either white or sometimes rose-purple. — Proc. Am. Acad. x. 40. From the mountains of Colorado and California to the far north.

Var. **acaulescens**, Gray. Smaller, with heads (solitary or several on the crown, encircled by the radical leaves) only inch and a half long, or less, and proportionally narrow: outer involucre bracts with a longer but rather weak prickle. — Mountains of Colorado to California.

7. **C. scariousus**, Gray. White with cottony tomentum, at least the lower face of the leaves: stem about a foot high: leaves of lanceolate outline, mostly pinnately parted into lanceolate long-prickly lobes; upper face sometimes villous, sometimes only cottony and early glabrate: heads 2 or 3 in a sessile cluster, or solitary on short leafy branches: innermost bracts of involucre commonly with more conspicuous erose or entire scarious tips: corollas pale or white. — Synopt. Fl. i. 402. Mountain plains, Wyoming and Utah.

+ + *Flowers usually rose or flesh-colored: involucre bracts closely appressed, coriaceous, commonly with a glandular or viscid ridge, short line or a broader spot on the back near the summit: heads naked, solitary or scattered.*

= *Leaves pinnately parted into narrow and linear mostly entire divisions.*

8. **C. Pitcheri**, Torr. A foot or two high, with herbage persistently white-tomentose throughout: lower leaves a foot or so long, with divisions either entire or some again pinnately parted into shorter lobes, weakly prickly-tipped; the winged rhachis not wider than the divisions: heads few or solitary, 2 inches high: involucre glabrate; the bracts rather small, viscid down the back, tipped with small short prickles: corollas ochroleucous. — Extending into the Dakotas and the northeastern limit of our range from the shores of the Great Lakes.

= = *Leaves from undivided to pinnately parted, the lobes lanceolate or broader, disposed to be white-tomentose above as well as below: prickles on cusp of involucre bracts more or less rigid.*

9. **C. ochrocentrus**, Gray. Resembles the next, usually taller, even to 6 or 8 feet high, the white tomentum mostly persistent: leaves commonly but not always deeply pinnatifid and armed with long yellowish prickles: heads 1 or 2 inches high: principal bracts of the involucre broader and flatter, the viscid line on the back narrow or not rarely obsolete, tipped with a prominent spreading yellowish prickle: corollas purple, rarely white. — Proc. Am. Acad. xix. 57. Plains, W. Texas to Colorado and Arizona.

10. **C. undulatus**, Gray. A foot or two high, persistently white-tomentose: leaves rarely pinnately parted, moderately prickly: heads commonly $1\frac{1}{2}$ inch high: principal bracts of the involucre mostly thickened on the back by the broader glandular-viscid ridge, comparatively small and narrow, tipped with an evident spreading short prickle: corollas rose-color, pale purple, or rarely white. — Proc. Am. Acad. x. 42. Plains, from Oregon to the Great Lakes and southward to New Mexico.

Var. **canescens**, Gray, is a form with smaller heads, sometimes not over an inch high, the leaves varying from ciliate spinulose-dentate to deeply pinnatifid. — New Mexico and S. Utah to Minnesota.

= = = *Leaves in the same species from undivided to pinnately parted, the lobes from ovate to lanceolate, upper face soon glabrate and green: involucre bracts tipped with weak prickles or sometimes hardly any.*

11. **C. altissimus**, Willd. Stem branching, 3 to 10 feet high: leaves in the typical form ovate-oblong or narrower, sometimes with merely spinulose-ciliate slightly toothed margins, sometimes lacinate-cleft or sinuate, or lower ones deeply sinuate-pinnatifid, weakly prickly: heads $1\frac{1}{2}$ to 2 inches high: involucre bracts firm-coriaceous, abruptly tipped with a spreading setiform prickle, the short outermost ovate or oblong: roots fascicled and not rarely tuberous-thickened below the middle, in the manner of *Dahlia*. — East of our range, but represented by

Var. **filipendulus**, Gray. Smaller, 2 or 3 feet high: roots tuberiferous: leaves commonly deeply pinnatifid: heads few, only $1\frac{1}{2}$ inch high. — Proc. Am. Acad. xix. 56. Prairies and thickets, Texas and Colorado.

12. **C. Virginianus**, Pursh. Stem slender, 2 or 3 feet high, simple or branching: leaves narrow, varying as in the last: *heads more naked-pedunculate, only an inch long*: involueral bracts small and narrow, thinner, tapering into a very weak short spreading bristle-like prickle, sometimes hardly any: flowers rose-purple. — From Colorado to Texas and Virginia.

72. KRIGIA, Schreb.

Low herbs: with rather large heads of yellow flowers terminating slender naked peduncles or scapes. Ours belongs to the § *Cynthia*, in which the involueral bracts are 9 to 18 and thin, and pappus of 10 to 15 oblong scales and 15 or 20 slender capillary bristles.

1. **K. amplexicaulis**, Nutt. Caulescent, not tuberiferous, glaucous: stem a foot or two high, 1 to 3-leaved, bearing one or two or few somewhat umbellate heads on moderately long peduncles: leaves oblong or oval, obtuse, entire, repand and denticulate, or radical somewhat lyrate-ly lobed; these contracted into winged petioles; cauline partly clasping by a broad base. — *Cynthia Virginica*, Don. From Colorado to New York and Georgia.

73. STEPHANOMERIA, Nutt.

Mostly smooth and glabrous; with branching or rarely virgate and often rigid or rush-like stems, small or merely scale-like leaves on the flowering branches, and usually paniculate heads of rose-colored or flesh-colored flowers. In ours the heads are $\frac{1}{4}$ to $\frac{1}{2}$ inch high, mostly 5-flowered and with about the same number of involueral bracts.

* *Perennials, paniculately branched from thick and tortuous roots, with striate and rush-like branches, small-leaved or nearly leafless above: pappus bristles not at all dilated at base, but plumose below the middle.*

1. **S. runcinata**, Nutt. *Comparatively stout and rigid, a foot or two high, with spreading branches*: heads mostly 4 or 5 lines high and scattered along the branches: *lower leaves runcinate-pinnatifid, commonly lanceolate*; upper linear or reduced to scales: pappus dull white, plumose only to near the base. — Plains, from Nebraska and Wyoming to Texas, Arizona, and California.

2. **S. minor**, Nutt. *More slender and with ascending branches bearing usually terminal and smaller heads: cauline leaves all slender, often filiform*: pappus white, very plumose down to base. — Plains and mountains, from the borders of British America to those of Mexico.

* * *Annuals or biennials: bristles of the white or whitish pappus plumose above but naked below the middle, at base more or less dilated.*

3. **S. exigua**, Nutt. A foot or two high, with slender branches and branchlets: radical and lower cauline leaves pinnatifid or bipinnatifid, those of the branches mainly reduced to short scales: bristles of the pappus 9 to 18, their more or less dilated or chaffy bases commonly a little connate. — From Wyoming to Texas and westward to Nevada and E. California.

74. **MICROSERIS**, Don.

Glabrous or merely puberulent, acaulescent or subcaulescent; with heads of yellow flowers terminating naked scapes or elongated simple peduncles.

* *Pappus of 15 to 20 white and soft plumose bristles with chaffy base: akenes linear-columnar, of same diameter from base to summit: stems more or less branching and leaf-bearing.*

1. **M. nutans**, Gray. Slender, a foot or so high: fusiform roots either fascicled or solitary: leaves from entire and spatulate-obovate to pinnately parted into narrow linear lobes: heads 8 to 20 flowered, slender-peduncled: involucre of 8 to 10 linear-lanceolate gradually acuminate principal bracts: bristles of pappus several times longer than the oblong scale at the base. — Proc. Am. Acad. ix. 208. From British Columbia and Montana to S. W. Colorado and California.

* * *Pappus of 20 to 24 narrowly linear-lanceolate silvery-white scales, occupying two or more series, very gradually attenuate into a slender awn: akenes attenuate-fusiform.*

2. **M. troximoides**, Gray. Acaulescent or nearly so: leaves tufted on the caudex, rather fleshy, narrowly linear-lanceolate, entire or undulate, 4 to 6 inches long: scapes a span to a foot high: involucre $\frac{3}{4}$ inch high: pappus $\frac{1}{2}$ inch or more long, its almost setiform scales $\frac{1}{4}$ line wide below. — Proc. Am. Acad. ix. 211. Hills and open plains, Montana and Idaho to Washington and California.

75. **MALACOTHRIX**, DC.

Leafy-stemmed or scapose; with pedunculate heads of yellow or white flowers, sometimes becoming purplish tinged. In ours the involucre is of narrow bracts and short-peduncled on the leafy spreading branches.

1. **M. sonchoides**, Torr. & Gray. A span to a foot high: lower leaves oblong, pinnatifid, with short and dentate lobes, rachis of the principal leaves also dentate: akenes linear-oblong, 15-striate-ribbed, somewhat angled by 5 moderately stronger ribs, the summit with a 15-denticulate white border. — Fl. ii. 486. Plains of W. Nebraska to New Mexico and westward.

76. **HIERACIUM**, Tourn. HAWKWEED.

Perennial herbs: often with toothed but never deeply lobed leaves: heads paniculate, rarely solitary: flowers yellow, or white in one species.

§ 1. *Involucre of the comparatively large heads irregularly more or less imbricated: pappus of copious and unequal bristles: akenes columnar, truncate. In ours the stems are leafy to the top, the cauline leaves all closely sessile.*

1. **H. umbellatum**, L. A foot or two high, strict, bearing a few somewhat umbellately disposed heads: leaves narrowly or sometimes broadly lanceolate, nearly entire, sparsely denticulate, occasionally laciniate-dentate, all narrow at base: involucre usually livid, glabrous or nearly so; outermost bracts loose or spreading. — From Lake Superior to the Rocky Mountains, and northward.

2. **H. Canadense**, Michx. Taller, robust, with corymbosely or paniculately cymose heads: leaves from lanceolate to ovate-oblong, acute, sparsely and acutely dentate or even lacinate, at least the upper partly clasping and broad or broadish at base: involucre usually pubescent when young, glabrate, occasionally glandular; the narrow outermost bracts loose: pappus sordid. — Across the continent near the British boundary and northward.

§ 2. *Involucre a series of equal bracts and a few short ones: pappus of more or less scanty equal bristles: akenes in some species slender or tapering to the summit.*

* *Hirsute with long and whitish or yellowish shaggy denticulate hairs commonly from a small papilla, commonly but not always on the involucre also: flowers yellow.*

3. **H. longipilum**, Torr. Stout, leafy to near the middle of the stem, and with linear-lanceolate or subulate bracts up to the narrow panicle: pubescence mainly glandular-setose and most abundant, the bristles upright, commonly $\frac{1}{2}$ to 1 inch long, fulvous or rufous: leaves spatulate-oblong or upper lanceolate, thickish, the radical commonly present in a tuft at flowering time: involucre 20 to 30-flowered, and with short peduncles more or less tomentulose as well as glandular, in a narrow almost virgate panicle: akenes fusiform: pappus at maturity fuscous. — Woods and prairies, from Nebraska to Texas, within the eastern limit of our range, and eastward to Michigan.

4. **H. Scouleri**, Hook. Robust, a foot or two high: hairs long and soft setose, whitish or yellowish: leaves lanceolate or spatulate-lanceolate, 3 to 6 inches long: panicle irregular or branching: involucre somewhat furfuraceous and glandular, also sparsely or copiously beset with long bristly hairs: akenes columnar and short: pappus whitish. — From Montana to Oregon and south to the Wasatch.

* * *Dark-hirsute and somewhat glandular (also whitish with short tomentum) on the involucre: leaves and lower part of scapiform stems not even pilose: flowers yellow: pappus sordid.*

5. **H. gracile**, Hook. Pale green, in tufts: leaves nearly all in radical clusters, obovate- to oblong-spatulate and attenuate into petioles, entire or repand-denticulate: stems or scapes slender, 8 to 18 inches high, cinereous above, bearing few or several racemously disposed livid heads, the lower linear-bracteate: involucre usually blackish-hairy at base: akenes short columnar. — Includes *H. triste*, mostly, of the Western Reports. Mountains of Colorado, Utah, and northward.

Var. **detonsum**, Gray. A span to nearly a foot high, with rather smaller heads: dark hirsute hairs wholly wanting, or only some smaller ones on the involucre. — Synopt. Fl. i. 427. *H. triste*, var. *detonsum*, Gray. Mountains of Colorado and California to those of British Columbia.

* * * *Not bristly (occasionally scattered bristles on the involucre and panicle), but at least the radical leaves and base of stem sparsely or thickly setose-hirsute with long spreading hairs.*

+ *Flowers white: stems leafy: akenes linear-columnar, not at all narrowed upward: pappus sordid: leaves entire or denticulate.*

6. **H. albiflorum**, Hook. A foot to a yard high, smaller plants with

simple and larger with compound open cyme: leaves oblong, thin, upper with usually narrowed sessile base, lower tapering into petiole: involucre of linear-lanceolate bracts, pale or livid, mostly glabrous or nearly so, not rarely a few bristly hairs. — From Colorado and Utah to California and British Columbia.

+ + *Flowers yellow: stems rather scapose (2 to several-leaved): leaves entire or slightly denticulate.*

7. **H. cynoglossoides**, Arvet. Stem a foot or less high (either from naked base or more commonly a radical tuft of leaves), simple, 2 to several-leaved, bearing few or several cymosely disposed heads, setose-hirsute or hispid at base: leaves lanceolate to spatulate-oblong, at least the lower conspicuously setose-hirsute; upper sometimes glabrous: involucre glandular, sometimes as also peduncles glandular-hispidulous: akenes rather short-columnar: pappus whitish. — Gray, Proc. Am. Acad. xix. 68. *H. Scouleri*, Hooker, partly. N. W. Wyoming and Montana to Oregon and California.

8. **H. Fendleri**, Schultz Bip. Subscapose, not rarely one or two leaves toward base of the simple or paniculately branching stem, sparsely setose-hirsute: radical leaves spatulate or broader; cauline verging to lanceolate, reduced above to linear bracts: heads few and racemiform-paniculate, or more numerous and corymbosely disposed: involucre puberulent or glabrate, with or without scattered setose hairs: akenes tapering from near the base to summit, sometimes reddish, at length commonly blackish: pappus copious, soft, sordid-whitish. — Colorado and New Mexico.

77. CREPIS, L.

Annuals or (ours) perennials, with soft white pappus and narrow-necked or beaked akenes (some truncate or merely tapering upwards): leaves entire or inclined to be pinnatifid: flowers all yellow.

* *Low or depressed, branched from the base, wholly glabrous, bearing numerous clustered heads: involucre of narrowly linear obtuse equal bracts: akenes narrow, 10-striate, having at summit a disk bearing the pappus.*

1. **C. nana**, Richards. Forming depressed tufts on creeping rootstocks: leaves chiefly radical, obovate to spatulate, entire, repand-dentate, or lyrate, commonly equalling the clustered scapes or stems: heads in fruit nearly $\frac{1}{2}$ inch high: akenes linear, unequally ribbed, obscurely contracted under the moderately dilated pappiferous disk. — Alpine mountain summits in Colorado and California, thence far northward.

2. **C. elegans**, Hook. Many-stemmed from a tap-root, diffusely branched: leaves entire or nearly so; radical spatulate, cauline from lanceolate to linear: heads smaller: akenes linear-fusiform, minutely scabrous on the equal narrow ribs, attenuate into a short slender beak, which is discoid-dilated at summit. — From Montana and the Dakotas to the Saskatchewan.

* * *More robust and taller, with scapiform or few-leaved stems and larger heads: akenes thicker, not dilated-discoid at the insertion of the pappus.*

+ *No canescent pubescence: foliage mostly glabrous: involucre many-flowered:*

its bracts narrow, acute, little thickened below after flowering: pappus not remarkably copious: leaves mostly radical.

3. **C. glauca**, Torr. & Gray. Usually scapose, 1 to 2 feet high, *glaucescent* or *glaucous*: radical leaves from obovate-spatulate to lanceolate, from entire to laciniate-pinnatifid: involucre 4 lines high, glabrous or nearly so, as also the peduncles: akenes oblong, with slightly narrowed summit, strongly and evenly 10-ribbed. — Fl. ii. 438. Moist ground, from the Saskatchewan and Nebraska to Utah and Nevada.

4. **C. runcinata**, Torr. & Gray. Not *glaucous* or slightly so, 1 to 2 feet high: radical leaves obovate-oblong to oblong-lanceolate, from repand to runcinate-pinnatifid with short lobes or teeth; cauline none, or small and narrow at the forks: involucre $\frac{1}{2}$ inch high or smaller, pubescent, often *hirsute*, sometimes (with peduncles and upper part of scape) glandular-hispidulous: akenes narrowly oblong, moderately narrowed upward, somewhat evenly 10-ribbed. — Loc. cit. In subalpine swamps, from Colorado and Utah to Montana and the Saskatchewan.

++ ++ *Cinereous-pubescent, at least the foliage: bracts of the involucre at length with more or less thickened or keeled midrib, at least at base: leaves usually laciniate-pinnatifid.*

++ *Principal bracts of the involucre and flowers 5 to 8: no hirsute pubescence: pappus moderately copious and soft.*

5. **C. acuminata**, Nutt. Minutely cinereous below, but green: stem slender, 1 to 3 feet high, 1 to 3-leaved, bearing a fastigate or corymbiform cyme of numerous small heads: leaves elongated, slender-petioled, oblong-lanceolate in outline, laciniate-pinnatifid, tapering to both ends, the apex usually into a lanceolate or linear tail-like prolongation: involucre $\frac{1}{2}$ to $\frac{1}{2}$ inch long, rarely over 6-flowered, smooth and glabrous: akenes at maturity fusiform, considerably longer than the pappus, lightly striate-costate, moderately attenuate at summit. — Dry ground, Montana and Wyoming to E. Oregon, Utah, and California.

6. **C. intermedia**, Gray. Habit and foliage of the preceding, or less tall, more cinereous-puberulent, usually with fewer heads: involucre $\frac{1}{2}$ inch or more long, canescently puberulent; its bracts in age more carinate by thickened midrib: akenes acutely 10 costate at maturity, oblong-fusiform, slightly attenuate upward, longer than or equalling the pappus. — Synopt. Fl. i. 432. *C. acuminata*, Gray, Bot. Calif., partly. Rocky Mountains in Colorado to the Sierra Nevada, California, and north to Washington.

Var. **gracilis**, Gray. A very slender form, with rhachis and apical prolongation as well as lobes of the leaves attenuate-linear. — Loc. cit. *C. occidentalis*, var. *gracilis*, Eaton.

++ ++ *Principal bracts of involucre 9 to 24 and flowers 10 to 30: pappus exceedingly copious and harsher.*

7. **C. occidentalis**, Nutt. Often hirsute as well as canescent, rather robust, a span to a foot or so high, commonly leafy-stemmed and branching: leaves oblong-lanceolate or broader in outline, variously laciniate-pinnatifid or incised, apex seldom much prolonged: involucre $\frac{1}{2}$ to $\frac{3}{4}$ inch high, canescent: akenes longer than the pappus, usually with tapering summit and acute ribs.

— Plains of Nebraska and Wyoming to Washington, and south to the mountains of Colorado and California.

78. PRENANTHES, Vaill.

Perennial herbs, with loosely paniculate heads, few-nerved akenes, and soft bright white pappus. Ours belong to the subgenus *Nabalus*, with more contracted inflorescence, dull-colored flowers, more nerved akenes, and stiffer sordid pappus.

1. *P. racemosa*, Michx. Stems simple, 1 to 5 feet high, leafy up to the inflorescence, with the leaves glabrous and glaucous: *leaves ordinarily only denticulate; radical and lower leaves spatulate-oblong to obovate, tapering into winged petioles; upper cauline lanceolate to ovate, partly clasping, the broader ones by a cordate or auriculate base: heads not at all drooping, crowded in an elongated thyrsus, a span to 2 feet long: involucre loosely hirsute: flowers purplish: akenes about 15-nerved, somewhat angled by 4 or 5 of the stronger nerves.* — *Nabalus racemosus*, DC. From Colorado to the Saskatchewan, thence eastward across the continent.

2. *P. alata*, Gray. A foot or two high, the larger plants branching: *leaves hastate-deltoid, sharply and irregularly dentate, abruptly contracted or some of the upper cuneately decurrent into winged petioles, or small uppermost narrower and sessile by a tapering base: heads somewhat pendulous, loosely and somewhat corymbosely paniculate: involucre of 8 to 10 greenish bracts: flowers purplish: akenes slender, at least sometimes with a tapering summit.* — Synopt. Fl. i. 435. *Nabalus alatus*, Hook. From the far north to Oregon, represented in the mountains of N. Montana by

Var. *sagittata*, Gray. Leaves sagittate or hastate, with basal lobes mostly slender and prolonged: heads in a virgate panicle: involucre pale green, very glabrous: immature akenes not tapering to the summit. — Loc. cit.

79. LYGODESMIA, Don.

Mostly smooth and glabrous; with usually rush like rigid or tough stems, linear or scale-like leaves, and terminal or scattered heads which are always erect: the flowers pink or rose-color.

* *Erect perennials, with striate-angled junciform stems and branches, and terminal solitary heads: akenes slender, terete, almost filiform, slightly tapering to summit: pappus soft and copious, whitish or sordid.*

1. *L. juncea*, Don. Fastigiately much branched from the deep-rooted base, about a foot high: leaves persistent, small, somewhat nervose; lower lanceolate-linear from a broadish base, inch or two long; upper reduced to small subulate scales: involucre at most $\frac{1}{2}$ inch long, 5-flowered: ligules $\frac{1}{4}$ or $\frac{1}{2}$ inch long. — Plains of the Saskatchewan and Minnesota to New Mexico and Nevada.

2. *L. grandiflora*, Torr & Gray. Stems separate or few from the root, simple below, a span to a foot high; the larger plants leafy, corymbosely branched above, and bearing few or numerous short-pedunculate heads: leaves all entire, of firm and thickish texture, linear-attenuate, 2 to 4 inches long, only

the very uppermost reduced to scales: involucre fully $\frac{3}{4}$ inch long, 5 to 10-flowered: *ligules of equal length, showy, rose-red*.—Fl. ii. 485. Gravelly hills, W. Wyoming and Utah.

* * *Paniculately branched annuals: pappus white and soft.*

3. **L. rostrata**, Gray. Stem erect, 1 to 3 feet high, striate, leafy, corymbose-paniculate: leaves narrowly linear, attenuate to both ends, entire, obscurely 3-nerved; cauline 3 to 7 inches long, barely 2 lines wide; uppermost slender-subulate: heads numerous, on scaly-bracteolate erect peduncles: involucre 8 to 9-flowered, of as many very narrowly linear bracts: rays small and narrow, probably purplish: akenes slender-fusiform, distinctly attenuate at summit, longer than the soft rather dull-white pappus.—Proc. Am. Acad. ix. 217. *L. juncea*, var. *rostrata*, Gray. Plains, from the Saskatchewan to Wyoming and Colorado.

80. TROXIMON, Nutt.

Acaulescent or nearly so; with a cluster of sessile or subsessile radical leaves, and simple scapes bearing a head of yellow or rarely purple flowers. Includes both *Troximon* and *Macrorhynchus* of the Western Reports.

§ 1. *Akenes beakless, or tapering gradually into a short and thickish beak, on which the nerves or ribs of the body are prolonged to the apex: pappus somewhat rigid*.—EUTROXIMON.

1. **T. cuspidatum**, Pursh. Glaucous, somewhat tomentose when young, a span to a foot high: leaves entire, elongated linear-lanceolate and upwardly linear-attenuate, mostly ciliate: involucre about an inch high; its bracts in 2 or 3 series, all tapering to a slender acumination, glabrous: akenes becoming 3 or 4 lines long, rather shorter than the unequal pappus, beakless.—Prairies, from the Dakotas to Wisconsin and W. Illinois.

2. **T. glaucum**, Nutt. Usually a foot or two high, rather stout, pale or glaucous, either glabrous or with loose pubescence: leaves linear to lanceolate, from entire to sparingly dentate or sometimes laciniate, 4 to 12 inches long: involucre commonly an inch high and many-flowered; its bracts lanceolate or broader; outer series shorter, often pubescent or even villous: akenes with the stout nerved beak 5 or 6 lines long, longer than the pappus.—*Macrorhynchus glaucus*, Eaton. Grassy plains, Saskatchewan and the Dakotas to British Columbia, and mountains of Utah and Colorado.

Var. **parviflorum**, Gray. A small and slender form: leaves only 2 to 6 inches long: scape a span to a foot high: head smaller and narrower.—Synopt. Fl. i. 437. *T. parviflorum*, Nutt. Plains of Nebraska and Wyoming to the mountains of New Mexico.

Var. **laciniatum**, Gray. Dwarf (a span or two high), with the small heads of the preceding variety, varying to larger, glabrous or glabrate, when young often cinereous-pubescent throughout: rays sometimes purplish externally or in fading: leaves mostly of lanceolate outline and lacinate-pinnatifid.—Bot. Calif. i. 437. Mountains of Colorado and New Mexico to California.

Var. **dasycephalum**, Torr. & Gray. Commonly robust, with large and broad heads: the involucre inch broad as well as high, and from villous to cinereous-pubescent, sometimes early glabrate: receptacle not rarely bearing

a few chaffy bracts among the flowers: leaves from elongated-lanceolate to oblong spatulate, from entire to laciniate or rarely pinnatifid: scape from a span to 2 feet high. — Mountains of Colorado to the Sierra Nevada and Washington, northeastward to the Dakotas and the Arctic regions.

§ 2. *Akenes with a slender and mostly filiform nerveless beak and soft pappus.* — MACRORHYNCHUS.

3. **T. aurantiacum**, Hook. Loosely soft-pubescent and glabrate: leaves from linear-lanceolate to spatulate, thinnish, entire, or sparingly laciniate-dentate, occasionally pinnatifid: scape from a span to a foot or more high: involucre 7 to 9 lines high; its bracts from broadly to narrowly lanceolate and acute, or outer and looser ones oblong and obtuse: flowers orange, commonly changing to brownish red or purple: *akenes thickish*, 3 or 4 lines long, and the *firm beak only 2 or 3 lines long: pappus somewhat rigidulous.* — *Macrorhynchus troximoides*, Torr. & Gray. Northern Rocky Mountains to British Columbia and Oregon, and mountains of Colorado.

Var. **purpureum**, Gray. Leaves apparently thickish, laciniate, and with the purple-tinged involucre very glabrous or glabrate: "flowers purple." — Proc. Am. Acad. xix. 72. New Mexico, and in the mountains of Colorado.

4. **T. gracilens**, Gray. Resembles *slender forms* of preceding: leaves *mostly entire*, flaccid, from lanceolate to nearly linear, or some narrowly spatulate: scape 10 to 18 inches high: head and involucre bracts narrow: flowers deep orange: *akenes fusiform-linear*, 3 or 4 lines long; *the very slender beak 4 or 5 lines long: pappus soft*, but not flaccid. — Proc. Am. Acad. xix. 71. Mountains in N. Wyoming to Oregon and Washington.

81. TARAXACUM, Haller. DANDELION.

Perennials, sending up in the spring, from a rosulate cluster of runcinate-pinnatifid or lyrate radical leaves, naked fistulous scapes, which elongate with and after the blooming of the showy head of yellow flowers: involucre reflexed at maturity: fruit, with the expanded pappus raised on the elongated beak, displayed in a globose body.

1. **T. officinale**, Weber. Root vertical: leaves from spatulate-oblong to lanceolate, from irregularly dentate to runcinate-pinnatifid: akenes oblong-obovate or narrower, abruptly contracted into a conical or pyramidal apex, which is prolonged into a filiform beak of twice or thrice the length of the akene. In the ordinary form of the fields the involucre bracts are obscurely or not at all corniculate, and the calyculate bracts are linear, elongated, and recurved; leaves usually lobed. — *T. Dens-leonis*, Desf. Common everywhere in fields and yards.

Var. **alpinum**, Koch. Outer involucre bracts ovate to broadly lanceolate, spreading, none conspicuously corniculate. — Labrador to British Columbia, and southward along higher mountains to Colorado and California.

Var. **lividum**, Koch. Outer involucre bracts ovate to ovate-lanceolate, all apt to be dark-colored in drying, obscurely or not at all corniculate: leaves from denticulate to runcinate-dentate, sometimes pinnatifid. — *T. palustre*, DC. Rocky Mountains, from New Mexico to the Arctic coast.

Var. *scopulorum*, Gray. Minute: leaves and scape an inch or less long: head 3 or in fruit even 5 lines high, narrow, few-flowered: outer involueral bracts lanceolate, rather loose; inner somewhat corniculate. — *T. levigatum*, Gray. Highest alpine region of the Rocky Mountains in Colorado.

82. PYRRHOPAPPUS, DC.

With leafy or (in ours) scapiform stems, undivided or pinnatifid leaves, and rather large slender pedunculate heads of golden yellow flowers. Our species is monocephalous.

1. *P. scaposus*, DC. Hirsutulous-pubescent, low and simple: globular tuber sending up a slender caudex, bearing at the surface of the ground a cluster of pinnatifid leaves and scapes of a span or two high: the latter simple and naked, sometimes a bract or small leaf near the base: head seldom an inch high in fruit: calyculate bracts of involucre short and small, subulate; principal ones obscurely corniculate at tip: flowers citron-yellow: pappus fulvous. — *P. grandiflorus*, Nutt. Prairies of Arkansas to E. Colorado.

83. LACTUCA,¹ Tourn. LETTUCE.

Mostly tall herbs, with milky juice, leafy stems, and paniculate heads of yellow, blue, or whitish flowers: involucre glabrous and smooth. Includes *Mulgedium*.

* *Akenes flat, orbicular to oblong, abruptly produced into a filiform beak of softer texture.*

1. *L. Ludoviciana*, DC. Glabrous, leafy to the open panicle, 2 to 5 feet high: leaves all oblong and auriculate-clasping, 3 or 4 inches long, sinuate-pinnatifid, somewhat spinulosely dentate, more or less bristly-ciliate, more or less hispidulous-setose on the midrib beneath: flowers yellow: akenes oblong-oval, about equalled by the filiform beak. — From the Dakotas and Wyoming to Iowa and Texas.

2. *L. pulchella*, DC. A foot or two high, very glabrous, glaucescent, leafy up to the open panicle: leaves from linear-lanceolate to narrowly oblong, entire or runcinate-dentate, or some lower ones pinnatifid; cauline sessile, with

¹ The Old World genus *Sonchus*, Tourn., ("Sow-Thistle,") with leafy stems, yellow flowers, and white pappus, has become extensively naturalized in the east, and the following species have appeared within our range: —

* Coarse annuals; with runcinately or lyrate pinnatifid leaves, beset with soft spinulose serratures; upper cauline auriculate-clasping: heads corymbose-paniculate: akenes flat, thin-edged, oblong-obovate

S. oleraceus, L., has leaves with soft and hardly spinulose teeth; auricles of the cauline ones acute; akenes striate-nerved and transversely rugulose-scabrous.

S. asper, Vill., has teeth of the leaves longer and more prickly; auricles of the clasping base rounded; and akenes smooth, 3-nerved on each side.

* * Strong-rooted perennial, with deep yellow flowers, and thickish akenes.

S. arvensis, L., has stems 2 feet high and naked at the summit; leaves as before, denticulate-spinulose, cauline partly clasping; peduncles and involucre more or less glandular-bristly; heads almost twice as long (1 inch high); akenes oblong, about 10-ribbed and rugulose on the ribs.

base not auriculate-clasping: flowers bright blue or violet-purple: akenes lanceolate-oblong, barely 2 lines long, striate-nervose; the tip of short (no longer than the breadth of the body) beak soft and usually whitish. — *Mulgedium pulchellum*, Nutt. From New Mexico to California, British Columbia, and eastward.

* * Akenes thickish, oblong, with some strong ribs and nerves, contracted at the summit into a short but manifest neck.

3. **L. leucophæa**, Gray. Stem 3 to 12 feet high, stout, leafy up to the pyramidal rather crowded panicle: leaves ample, sinuately or runcinately pinnatifid, coarsely and irregularly or doubly dentate; upper cauline sessile by a mostly narrowed but auriculate or partly clasping base: involucre oblong, 5 lines high: flowers bluish to yellowish or whitish: pappus sordid or fuscous. — *Mulgedium leucophæum*, DC. Across the continent from Oregon to the mountains of Carolina and northward.

ORDER 43. LOBELIACEÆ. (LOBELIA FAMILY.)

Herbs with milky juice, alternate leaves, scattered flowers, irregular 5-lobed corolla, and the 5 stamens free from the corolla and united into a tube commonly by their filaments and always by their anthers. Calyx-tube adherent to the 2-celled, many-seeded capsule: style one.

1. **Lobelia**. Corolla open down to the base on one side.

2. **Laurentia**. Corolla with a closed tube. Capsule wholly inferior.

1. LOBELIA, L.

Calyx-tube 5-cleft, with a short tube. Corolla with a straight tube and somewhat 2-lipped; the upper lip of 2 rather erect lobes, the lower lip spreading and 3-cleft. Capsule 2-celled, opening at the top. — Flowers axillary or chiefly in bracted racemes.

1. **L. cardinalis**, L. Stem tall, simple, 2 to 4 feet high, smoothish: leaves oblong-lanceolate, slightly toothed: raceme elongated, rather one-sided: flowers large, deep red; the pedicels much shorter than the leaf-like bracts. — Colorado, and throughout the States eastward. The intense red of the flower varies to rose-color and even white. Known as "Cardinal Flower."

2. **L. syphilitica**, L. Stems simple, 2 to 3 feet high, leafy to the top, somewhat hairy: leaves thin, oblong or ovate-lanceolate, acute at both ends, irregularly serrate: flowers in a long spike-like raceme, light blue, rarely white: sinuses of the calyx with deflexed auricles. — From Colorado to the Dakotas and throughout the States eastward.

2. LAURENTIA, Michx.

Calyx-tube turbinate or oblong. Corolla with its tube as long as the limb, which is like that of *Lobelia*. Capsule short, 2-valved at the summit. — Low herbs, resembling small species of *Lobelia*, excepting the closed tube of the corolla. Flowers blue.

1. **L. carnosula**, Benth. Annual, rooting in the mud, glabrous, 1 to 5 inches high: leaves oblong-linear or lanceolate, entire, sessile, $\frac{1}{4}$ to $\frac{1}{2}$ inch long: flowers axillary and above corymbose or racemose, long-pedicelled. — Gray, Bot. Calif. i. 444. *Porterella carnosula*, Torr., of Hayd. Rep. 1872, 488. Muddy borders of ponds and streams from the Californian Sierras to Utah and Wyoming.

ORDER 44. CAMPANULACEÆ. (CAMPANULA FAMILY.)

Like the *Lobeliaceæ*, but the corolla regular bell-shaped, the stamens usually distinct and the capsule (in ours) 3-celled. — Flowers generally blue and showy.

1. **Specularia**. Calyx-tube more or less elongated and narrow. Corolla short and broad, rotate when expanded. Capsule prismatic or elongated.
2. **Campanula**. Calyx-tube short and broad. Corolla generally bell-shaped. Capsule mostly short.

1. SPECULARIA, Heister. VENUS'S LOOKING-GLASS.

Flowers dimorphous; the earlier ones smaller, with undeveloped corolla, and a 3 or 4-lobed calyx. The calyx-lobes of the later corolliferous flowers 5. Capsule with valvular openings either near the summit or near the middle. — Annuals, with leafy slender stems, and sessile flowers. Corolla blue or purplish.

1. **S. leptocarpa**, Gray. Minutely hirsute or nearly glabrous: stems a span or two high, virgate, mostly simple or branched from the base: leaves lanceolate: capsule nearly cylindrical, $\frac{1}{2}$ to $\frac{3}{4}$ inch long, inclined to curve and rarely to twist, opening by one or two uplifted valves near the summit; the lowest also often splitting longitudinally from the summit: seeds oblong. — Proc. Am. Acad. xi. 82. Arkansas to W. Texas and Colorado.

2. **S. perfoliata**, A. DC. Stems 8 to 20 inches high, very leafy throughout, hirsute or hispid on the angles: leaves round-cordate and clasping, mostly crenate, veiny: flowers single or clustered in the axils: capsule oblong or somewhat obconical; the 2 or 3 valvular openings at or below the middle; the capsule not disposed to split: seeds lenticular. — From Colorado to Utah and Oregon, also throughout the States eastward.

2. CAMPANULA, Tourn. BELL-FLOWER, HAREBELL.

Flowers all alike and corolliferous. Filaments dilated at base. Capsule opening on the sides or near the base by 3 to 5 small uplifted valves or perforations. — Flowers blue or white. Ours have naked sinuses to the calyx.

* Capsule opening near or at the summit, erect: low and usually 1-flowered alpine or subalpine plants.

1. **C. uniflora**, L. Chiefly glabrous, 1 to 4 inches high, from a stout several-headed rootstock: leaves small, an inch or less long, thickish, entire or nearly so; the lowest spatulate or oblong, obtuse; uppermost linear: flowers 4 to 6 lines in length, mostly horizontal: calyx-tube nearly as long as the lobes,

which are from half to fully as long as the *deeply campanulate bluish corolla*: capsule cylindraceous or clavate, $\frac{1}{2}$ inch long. — On bare alpine slopes in the Colorado Rocky Mountains, and extending into the arctic regions.

2. **C. planiflora**, Engelm. Glabrous, from a few inches to a span high, from a *filiform rootstock* bearing similar subterranean stolons: *leaves* 1 to 2 inches long, lanceolate to linear-lanceolate, the lowest ones sometimes broader, *all more or less dentate or denticulate*: *flowers larger, erect*: calyx-lobes several times longer than the tube and exceeding the tube of the *shallow, wide open, reddish-purple corolla*: capsule ovate or turbinate, as long as the calyx-lobes or shorter. — Bot. Gaz. vii. 5. *C. Langsdorffiana* of the Rocky Mountain Floras. *C. Scheuchzeri*, Gray, Fl. N. Am., as to Colorado forms. In subalpine meadows, Colorado. The large shallow corolla is four times wider than deep.

* * Capsule opening near or at the base: taller, usually several to many-flowered, and in lower ground: rootstocks filiform.

3. **C. rotundifolia**, L. Stems diffuse or erect, a foot or two long, 1 to 9-flowered, smooth: radical leaves slender-petioled, orbicular or cordate; cauline leaves linear: flower-buds erect: calyx-lobes setaceous-subulate: corolla bright blue, campanulate, $\frac{1}{2}$ to 1 inch long: capsule nodding. — A subarctic species, ranging southward in the mountains to Mexico.

4. **C. aparinoides**, Pursh. Stem almost filiform, a foot or two high, equally leafy to the top, its sharp angles rough with short retrorse bristles: so also the midrib beneath and the margins of the lanceolate or linear sessile leaves: flower-buds drooping: calyx-lobes triangular: corolla pale blue or whitish, deeply cleft, the lobes 2 lines long or less: capsule erect. — Wet grassy grounds from Colorado to the Saskatchewan and eastward.

ORDER 45. ERICACEÆ. (HEATH FAMILY.)

Shrubs, sometimes herbs, with the flowers regular or nearly so, the stamens as many or twice as many as the 4 to 5 lobes or petals of the corolla, free or nearly free from it, anthers 2-celled, commonly appendaged or opening by terminal chinks or pores, style one, ovary 3 to 10-celled.

SUBORDER I. VACCINIEÆ.

Calyx-tube adnate to the ovary, which forms a berry crowned with the calyx-teeth. Corolla always gamopetalous and epigynous. — Shrubby or suffrutescent, with scaly buds and alternate leaves.

1. **Vaccinium**. Ovary 4 to 5-celled, or by false partitions from the back of these cells 8 to 10-celled, wholly inferior: ovules numerous. Anther-cells tapering upward into a tube.

SUBORDER II. ERICINEÆ.

Calyx free from the ovary. Corolla gamopetalous or rarely polypetalous, hypogynous. — Shrubs or small trees.

* Fruit fleshy, either a berry or drupe.

2. **Arctostaphylos**. Corolla urn-shaped. Stamens twice as many as the corolla lobes, included. Drupe berry-like, 5 to 10-seeded.

- * * Fruit a loculicidal capsule, 5-celled and many-seeded. (In ours the calyx becomes fleshy in fruit, enclosing the small capsules, and hence the fruit resembles a berry.)
3. **Gaultheria.** Calyx 5-cleft, its lobes imbricated. Corolla ovate, urn-shaped to campanulate. Stamens 10: filaments dilated towards the base: anthers usually awned. Capsule deeply umbilicate.

* * * Fruit a septicidal capsule: anthers destitute of awns or appendages.

- + Corolla gamopetalous: flowers not from scaly buds, the bracts being leaf-like or coriaceous: capsule globular.
4. **Bryanthus.** Corolla from campanulate to ovoid, 4 to 6-lobed. Stamens 8 to 10, straight. Leaves heath-like, alternate but crowded.
5. **Kalmia.** Corolla crateriform or saucer-shaped, 5-lobed, with 10 pouches below the limb. Stamens 10: the short anthers lodged in the corolla pouches in bud, so that in blooming the filaments are strongly recurved. Leaves alternate, opposite, or whorled, flat.
- + + Corolla polypetalous or very nearly so: flowers from large scaly buds, the scales of bracts caducous: capsule oval or oblong.
6. **Ledum.** Calyx 5-lobed or parted, small. Petals oval or obovate, widely spreading. Stamens 5 to 10. Leaves evergreen.

SUBORDER III. PYROLINEÆ.

Calyx free from the ovary. Corolla polypetalous, hypogynous. Anthers erect and extrorse in bud, with an emarginate or 2-horned base, where each cell opens by a pore; but inverted in anthesis so that the real base with its pores becomes apical. Fruit a loculicidal capsule. — Ours are herbs or nearly so, with broad evergreen leaves and a scape naked or nearly so.

7. **Moneses.** Flowers solitary, 4 or 5-merous. Petals widely spreading, orbicular. Stamens 8 or 10: anthers conspicuously 2-horned. Style straight. Valves of the capsule not woolly on the edges.
8. **Pyrola.** Flowers in a raceme, 5-merous. Petals concave or incurved and more or less converging. Stamens 10, often declined. Style often declined or turned downward. Valves of the capsule cobwebby on the edges.

SUBORDER IV. MONOTROPEÆ.

Flowers nearly as in Suborders II. and III., but the plants herbaceous, root-parasitic, scaly, entirely destitute of green foliage.

9. **Pterospora.** Corolla gamopetalous, 5-toothed. Anthers 2-celled, 2-awned on the back, opening lengthwise.
10. **Monotropa.** Corolla of 4 or 5 separate narrow petals. Anthers kidney-shaped, the cells more or less confluent, opening across the top.

1. VACCINIUM, L. BLUEBERRY. BILBERRY.

Ours all belong to § EUVACCINIUM, which has a corolla from ovate to globular and more or less urn-shaped, 4 to 5-toothed, rose-color or nearly white: anthers 2-awned on the back, included: ovary and berry 4 to 5-celled, with no false partitions: leaves deciduous: flowers on drooping pedicels, solitary or 2 to 4 together, developing with or soon after the leaves.

* *Flowers solitary or 2 to 4 in a fascicle, from a distinct scaly bud, more commonly 4-merous and 8-androus: leaves entire, sessile or nearly so: limb of the calyx deeply 4 to 5-parted: berries blackish-blue with a bloom.*

1. **V. occidentale**, Gray. A foot or more high, glabrous: leaves glaucous, obscurely veiny, from oval to obovate-oblong or oblanceolate, obtuse or acutish: flower mostly solitary from the scaly bud: berry small, barely 3 lines in diameter. — Bot. Calif. i. 451. In the Uinta Mountains and westward in the Sierra Nevada.

* * *Flowers solitary in the earliest axils, usually 5-merous and 10-androus: calyx less or very slightly lobed.*

+- *Dwarf and caespitose: branches not angled.*

2. **V. cæspitosum**, Michx. Glabrous or nearly so, 3 to 6 inches high: leaves from obovate to cuneate-oblong, thickly serrulate, bright green both sides, reticulate-veiny ($\frac{3}{4}$ to 1 inch long): berry proportionally large, blue with a bloom, sweet. — From the Colorado mountains to Alaska, and eastward in Labrador and the White Mountains.

Var. **cuneifolium**, Nutt. A span to near a foot high, bushy: leaves spatulate-cuneate and with rounded apex, passing in one form to spatulate-lanceolate and acute; the earliest not rarely entire. — Mountains of Colorado to California, British Columbia, and Lake Superior.

+ + *Low: branches sharply angled and green: leaves small.*

3. **V. Myrtillus**, L. A foot or less high, glabrous: leaves ovate or oval, thin, shining, serrate, conspicuously reticulated-veiny, and with a prominent narrow midrib ($\frac{1}{2}$ to $\frac{3}{8}$ inch long): limb of calyx almost entire: corolla globular-ovate: berries black, nodding. — From Colorado and Utah northward to Alaska. Known as "Whortleberry" or "Bilberry."

Var. **microphyllum**, Hook. A diminutive form, 3 to 6 inches high: leaves 2 to 4 lines long: corolla proportionally small, a line long: berries at first "light red." — Colorado, Utah, and in the Sierras and northward.

2. ARCTOSTAPHYLOS, Adans. BEARBERRY. MANZANITA.

Shrubs with alternate leaves, and small mostly white or rose-colored flowers variously clustered.

1. **A. Uva-ursi**, Spreng. Depressed-trailing or creeping, green: leaves coriaceous and evergreen, oblong-spatulate, retuse, an inch or less long, tapering into a petiole: flowers rather few in simple small clusters, 2 lines long: ovary and reddish fruit glabrous: nutlets 1-nerved on the back. — From New Mexico to Pennsylvania, California, and northward. Often called "Kinnikinnick," as well as "Bearberry."

3. GAULTHERIA, Kalm. AROMATIC WINTERGREEN.

Shrubs or almost herbaceous; with broad evergreen leaves, shining above, and usually spicy-aromatic in flavor, axillary white or rose-colored nodding flowers in early summer.

1. **G. Myrsinites**, Hook. Cespitose-procumbent or depressed, a few inches high: leaves orbicular or ovate, denticulate with minute bristle-tipped

teeth ($\frac{1}{4}$ to $1\frac{1}{2}$ inches long): pedicels solitary in the axils, very short: corolla depressed-campanulate, little exceeding the calyx: apex of anthers obscurely 4-pointed: fruit scarlet, with pine-apple flavor.—In the mountains from Colorado and Utah to British America and westward.

4. BRYANTHUS, Steller, Gmelin.

Heath-like alpine evergreens; with much crowded linear-obtuse leaves ($\frac{1}{2}$ inch or less long). In ours the flowers are racemose-clustered at the summit of the branches, the pedicels glandular and subtended by foliaceous and rigid bracts, and the almost smooth leaves have strongly revolute thickened margins.

1. *B. empetriformis*, Gray. A span or more high: pedicels somewhat umbellate: corolla rose-color, 2 or 3 lines long, campanulate, barely 5-lobed; the lobes much shorter than the tube: stamens included: style either included or exserted.—Proc. Am. Acad. vii. 377. Mountains of W. Wyoming, Montana, and northwestward.

5. KALMIA, L. AMERICAN LAUREL.

Leaves evergreen and entire: the showy flowers umbellate-clustered, rose-colored, purple or white: limb of the corolla in bud strongly 10-keeled from the pouches upward, the salient keels running to the apex of the lobes and to the sinuses.

1. *K. glauca*, Ait. Shrub 1 or 2 feet high, glabrous, mostly glaucous, branchlets 2-edged: leaves all opposite or rarely in threes, almost sessile, oblong or linear-oblong, or appearing narrower by the usual strong revolution of the edges, glaucous-white beneath: flowers in spring in a simple terminal umbel or corymb, lilac-purple, $\frac{1}{2}$ to $\frac{3}{4}$ inch in diameter.—Bogs, Colorado and northward, thence eastward across the continent. The forms extending southward into the Colorado mountains are depauperate alpine forms a span high and with leaves barely $\frac{1}{2}$ inch long (var. *microphylla*, Hook.).

6. LEDUM, L. LABRADOR TEA.

Low shrubs, with alternate persistent leaves, which are entire and more or less resinous-dotted, slightly fragrant when bruised: flowers white, developed in early summer from terminal or sometimes lateral buds; pedicels recurved in fruit.

1. *L. glandulosum*, Nutt. Shrub 2 to 6 feet high, stout: leaves oblong or oval, or approaching lanceolate (1 or 2 inches long), glabrous both sides, pale or whitish and minutely resinous-atomiferous beneath: inflorescence often compound and crowded: capsules oval, retuse.—From California northward and eastward into British America, occurring in the northwestern border of our range.

7. MONESES, Salisb.

Cells of the anther oblong, abruptly constricted under the orifice into a conspicuous short-tubular neck.

1. *M. uniflora*, Gray. Herb with 1-flowered scape 2 to 4 inches high, a cluster of roundish and serrulate thin leaves at base, on a short stem or the ascending summit of a filiform rootstock: corolla white or tinged with rose-color, about $\frac{3}{8}$ inch in diameter. — Deep moist woods, Colorado and Utah to Oregon, Pennsylvania, and northward.

8. PYROLA, TOURN. WINTERGREEN. SHIN-LEAF.

Acaulescent evergreens; with a cluster of round or roundish leaves, and some scarios scales on the ascending summit of slender subterranean rootstocks: scape more or less scaly-bracted, bearing a raceme of white, greenish, or purplish nodding flowers, in summer.

* *Style straight, much narrower than the expanded depressed 5-rayed stigma: anthers not narrowed below the openings.*

1. *P. minor*, L. *Leaves orbicular, thinnish, obscurely serrulate or crenulate, an inch or less long: scape a span high, 7 to 15-flowered: petals white or flesh-colored, orbicular, naked at the base, globose-connivent: stigma peltate, large, obscurely 5-lobed: hypogynous disk none.* — Mountains from New Mexico to Oregon and northward, thence eastward across the continent.

2. *P. secunda*, L. *Inclined to be caulescent from a branching base: leaves thin, ovate, serrulate or crenate, 1 or 2 inches long: scape a span long, bearing numerous flowers in a secund spike-like raceme: petals greenish white, oblong, each with a pair of tubercles on the base, equally connivent: stigma peltate, large, 5-lobed: hypogynous disk 10-lobed.* — Mountains of Colorado, California, and far northward and eastward.

* * *Style strongly declined or decurved and toward the apex more or less curved upward, longer than the concave somewhat campanulate-connivent or partly spreading petals: stigma much narrower than the truncate and usually excavated apex of the style, which forms a ring or collar: anthers more or less contracted under the terminal orifices.*

3. *P. chlorantha*, Swartz. *Leaves small ($\frac{1}{2}$ to 1 inch in diameter), orbicular or nearly so, coriaceous, not shining, shorter than the petiole: scape 4 to 8 inches high, 3 to 10-flowered: calyx-lobes very short and obtuse or rounded, appressed to the greenish-white corolla: anther-cells with distinctly beaked tips.* — Mountains of Colorado, northward and eastward.

4. *P. elliptica*, Nutt. *Leaves oval or broadly oblong, $1\frac{1}{2}$ to $2\frac{1}{2}$ inches long, membranaceous, acute or merely roundish at base, longer than their petioles, plicately serrulate: scape a span or more high, loosely several to many-flowered: calyx-lobes ovate and acute, short: corolla greenish white: anther-tips hardly at all beaked.* — Mountains of New Mexico to British Columbia, the N. Atlantic States, and Canada.

5. *P. rotundifolia*, L. *Leaves generally orbicular or broadly oval, $1\frac{1}{2}$ to 2 inches long, obscurely crenulate or entire, coriaceous, shining above, mostly shorter than the slender petioles: scape a span to a foot high, several to many-flowered, scaly-bracteate: calyx-lobes lanceolate to ovate-lanceolate, usually $\frac{1}{2}$ or $\frac{1}{3}$ the length of the white or flesh-colored petals.* — Dry woods, from California, New Mexico, and Georgia, northward to the arctic regions.

Var. *uliginosa*, Gray. *Calyx-lobes* shorter, usually broadly ovate, sometimes obtuse: leaves from subcordate to obovate, generally dull: flowers rose-colored or purple — Cold bogs, nearly across the continent to the north.

6. *P. picta*, Smith. Leaves firm-coriaceous, dull, commonly veined or blotched with white above, pale or sometimes purplish beneath, 1 to $2\frac{1}{2}$ inches long, from broadly ovate to spatulate or narrowly oblong, all longer than the petiole, the margins quite entire or rarely remotely denticulate: scapes a span or more high, 7 to 15-flowered: bracts few and short: *calyx-lobes* ovate, not half the length of the greenish-white petals. — Wyoming and S. Utah to California and northward.

9. PTEROSPORA, Nutt. PINE-DROPS.

Calyx deeply 5-parted. Corolla globular urn-shaped. Stamens 10, included. Disk none. Stigma 5-lobed. Capsule depressed-globular, 5-lobed. Seeds innumerable, broadly winged from the apex.

1. *P. andromedea*, Nutt. A chestnut-colored or purplish herb, glandular and clammy-pubescent: simple stem 1 to 3 feet high, bearing small and scattered lanceolate scales: raceme long and many-flowered: corolla white, $\frac{1}{4}$ inch long, somewhat viscid. — Under pines and oaks from Colorado to California northward, and eastward across the continent.

10. MONOTROPA, L. INDIAN PIPE. PINE-SAP.

Sepals of 2 to 5 lanceolate bract-like scales. Petals scale-like and fleshy, gibbous or saccate at base. Stamens 8 to 12. Disk 8 to 12-toothed, the teeth deflexed. Stigma funnelform, with obscurely crenate margin. Capsule ovoid. — White, tawny, or reddish scaly and fleshy herbs, the clustered stems rising from a thick and matted mass of fibrous rootlets, one to several-flowered.

* *Plant* inodorous, one-flowered: scales passing into an imperfect or irregular calyx of 2 to 4 loose sepals or perhaps bracts: anthers opening at first by 2 transverse chunks, at length 2-valved; the valves almost equal and equally spreading: edge of the stigma naked.

1. *M. uniflora*, L. Smooth, a span or so high, waxy-white (blackish in drying), rarely flesh color: flower nodding, $\frac{3}{8}$ inch long: petals 5, rarely 6. — Damp woods, nearly throughout the continent. "Indian Pipe."

* * *Plant* often scented, commonly pubescent, at least above, racemosely 3 to several-flowered: terminal flower earliest and usually 5-merous and the lateral 3 to 4-merous: sepals less bract-like, as many as the petals; the latter saccate at base: anthers more reniform; the cells completely confluent into one, which opens by very unequal valves, the larger broad and spreading, the other remaining erect and contracted: stigma glandular or hairy on the margin.

2. *M. Hypopitys*, L. A span or at length a foot high, tawny or flesh-colored: scales and bracts entire or slightly erose: flowers less than $\frac{1}{2}$ inch long; the lateral 4-petalous and 8-androus. — Under coniferous trees from Oregon to Canada and Florida. "Pine-sap."

ORDER 46. PRIMULACEÆ. (PRIMROSE FAMILY.)

Herbs with simple leaves and regular perfect flowers, the stamens as many as the lobes of the gamopetalous corolla and inserted opposite them, a one-celled ovary with a free central placenta rising from the base, bearing several or many seeds. Style and stigma one.

* Ovary wholly free.

+ With scapes or tufted: flowers chiefly 5-merous, umbellate or solitary: capsule dehiscent by valves: lobes of the corolla imbricated in the bud.

++ Stamens exserted, connivent in a cone, monadelphous.

1. **Dodecatheon.** Corolla 5-parted, with very short tube and dilated thickened throat, the long and narrow divisions reflexed. Stamens inserted on the throat of the corolla: anthers lanceolate or linear.

++ ++ Stamens included, distinct, with short filaments and short blunt anthers: corolla salverform or funnelform.

2. **Primula.** Corolla with tube surpassing or at least equalling the calyx, and spreading mostly obcordate or emarginate lobes. Capsule many-seeded. Leaves all radical.

3. **Douglasia.** Corolla with tube equalling or surpassing the calyx, somewhat inflated above; lobes entire. Ovary 5-ovuled. Capsule 1 or 2-seeded. Leaves imbricated or crowded on tufted stems.

4. **Androsace.** Corolla with tube shorter than the calyx; the throat constricted. Ovules and seeds numerous or few. Flowers small.

+ + Leafy-stemmed: corolla (wanting in *Glaux*) rotate or somewhat so, and the divisions convolute or sometimes involute in the bud: leaves entire.

++ Capsule dehiscent vertically by valves or irregularly, mostly globose: flowers 5-merous.

5. **Steironema.** Corolla rotate, with no proper tube, deeply parted the divisions ovate, cuspidate-pointed, erose-denticulate above, each separately involute or convolute around its stamen. Filaments distinct or nearly so on the ring at the base of the corolla: anthers linear and arcuate in age: sterile filaments 5, interposed between the fertile ones. Capsule 10 to 20-seeded. Flowers nodding on slender peduncles. Leaves opposite, without dots.

6. **Glaux.** Corolla none. Calyx with 5 petaloid lobes. Stamens on the base of the calyx, alternate with its lobes: filaments slender: anthers cordate-ovate. Capsule 5-valved at apex, few-seeded. Leafy throughout: leaves mainly opposite. Flowers solitary, axillary, nearly sessile.

++ ++ Capsule circumscissile, globose: seeds numerous.

7. **Centunculus.** Corolla with a globular tube and a 4 to 5-lobed limb, shorter than the calyx; lobes acute. Stamens on the tube of the corolla: filaments short and subulate: anthers ovate or cordate.

* * Ovary connate at base with the calyx.

8. **Samolus.** Flowers 5-merous. Corolla perigynous, nearly campanulate. Fertile stamens 5, on the tube of the corolla, with short filaments and cordate anthers. Sterile filaments 5 in the sinuses of the corolla. Capsule ovate or globular, 5-valved at the apex, many-seeded. Caulescent, alternate-leaved, with racemose flowers.

1. DODECATHEON, L. SHOOTING-STAR. AMERICAN COWSLIP.

Flowers few or numerous in an umbel terminating a naked scape: corolla from pink-purple to white. Calyx erect in fruit, enclosing the lower part of the capsule.

1. **D. Meadia**, L. Leaves crowded on a thickish crown, generally spatulate-oblong or oblanceolate and entire or nearly so, sometimes repand, obtuse, below tapering into a more or less margined petiole: scape from a span to 2 feet high: flowers few to many in an umbel; bracts of the involucre linear or subulate, small; pedicels slender and nodding with the flowers, erect in fruit. — Throughout the continent and exceedingly variable, especially westward.

Var. **alpinum**, Gray. Leaves oblanceolate or spatulate, $\frac{1}{2}$ to $1\frac{1}{2}$ inch long, entire, mucronate: scape 2 to 10 inches long, 1 to 4-flowered. — Synopt. Fl. ii. 57. From the Rocky Mountains to the Sierras.

Var. **frigidum**, Gray. Leaves from obovate to oblong, very obtuse, mostly entire, 1 to 2 inches long, with a slender petiole: scape a span or two high, few to several-flowered: lobes of the calyx longer than the tube, from broadly lanceolate to almost ovate, shorter than the capsule. — Synopt. Fl. ii. 57. Rocky Mountains, Sierras, and far northward.

Var. **latilobum**, Gray. Leaves thin, ovate or oval, repand or undulate-toothed, long-petioled: scape a span to a foot high, one to several-flowered: calyx-lobes not longer than the tube, ovate or triangular-ovate, about half the length of the capsule. — Synopt. Fl. ii. 58. Wasatch Mountains to Washington and British Columbia.

2. PRIMULA, L. PRIMROSE.

Flowers sometimes dimorphous. Perennial plants, mostly with fibrous roots from a short crown, glabrous or nearly so.

* *Flowers small; tube of the salverform corolla not over 2 or 3 lines long and little surpassing the calyx; throat with more or less of a callous ring or processes.*

1. **P. farinosa**, L. More or less white mealy on the leaves, calyx, etc., at least when young: leaves from cuneate-lanceolate to obovate-oblong or spatulate, denticulate, an inch or less long, tapering into a short margined petiole: scape 3 to 9 inches high: umbel few to several-flowered, close: corolla from flesh-color to lilac, with yellowish eye; the lobes cuneate-obcordate, rather distant at base. — From Colorado northward, thence eastward to Maine and Labrador.

* * *Flowers larger; tube of the corolla from 3 to 6 lines long; throat open and unappendaged: leaves clustered on the short erect subterranean crown.*

2. **P. angustifolia**, Torr. *Small: scape 1-flowered, 1 or 2 inches high, equalling the lanceolate-spatulate obtuse entire short-petioled leaves: involucre of 1 or 2 minute bracts: lobes of the lilac-purple corolla obovate, emarginate (3 or 4 lines long); the tube hardly exceeding the narrow teeth of the oblong calyx.* — Ann. Lyc. N. Y. i. 34. Alpine in Colorado and New Mexico.

3. **P. Parryi**, Gray. *Large: leaves rather succulent, spatulate-oblong or oblanceolate, 4 to 12 inches long, often denticulate: scape a span to a foot high, 5 to 12-flowered: bracts of the involucre subulate: calyx ovoid-campanulate, glandular, commonly reddish; the lanceolate-subulate lobes as long as the tube: corolla crimson-purple with yellow eye; the round obovate lobes (5 lines long) emarginate or obcordate.* — Amer. Jour. Sci. II. xxxiv. 257. Along alpine brooks from Colorado to Arizona and Nevada.

3. DOUGLASIA, Lindl.

Depressed and tufted herbs: the stems branching, persistent: the leaves small, linear, imbricated or rosulate on the branches, or some of them scattered and alternate. In ours the flowers are solitary, terminating the leafy shoots, and the tube of the corolla barely equals the calyx.

1. *D. montana*, Gray. Pulvinate-cespitose, 1 or 2 inches high, nearly glabrous: leaves subulate, minutely somewhat ciliate, 2 lines long, somewhat interruptedly imbricate-clustered: pedicel 1 to 2-bracteolate near the calyx: corolla-lobes cuculate-obovate, 2 lines long. — Proc. Am. Acad. vii. 371. Mountains about Helena, Montana, and Owl Creek Mountains, Wyoming.

4. ANDROSACE, Tourn.

Small annuals or perennials of various habit: flowers umbellate, white.

* *Perennials, proliferously branched at base and cespitose: leaves rosulate-imbricated at the base of the many-flowered scapes: capsule usually few-seeded.*

1. *A. Chamæjasme*, Host. Leaves in more or less open rosulate tufts, from lanceolate to oblong-spatulate or ovate, carinate 1-nerved, their margins (at least), the scape (1 to 3 inches high) and the somewhat capitate umbel villous with many-jointed hairs: corolla white with yellowish eye. — Alpine from Colorado and northward to the Arctic coast.

* * *Annuals, acaulescent, with slender root, an open rosulate circle of leaves, and naked scapes, bearing an involucre umbel: capsule many-seeded.*

+ *Calyx-tube obpyramidal in fruit, whitish with conspicuous green teeth, which mostly surpass the capsule.*

2. *A. occidentalis*, Pursh. Minutely pubescent, not over 3 inches high: radical leaves and those of the conspicuous involucre oblong-ovate or spatulate, entire, sessile: scapes diffuse: bracts of the involucre ovate or oblong: lobes of the calyx as long as the tube: lobes of the corolla oblong, shorter than the calyx. — From New Mexico to the head-waters of the Missouri and eastward to the Mississippi.

3. *A. septentrionalis*, L. Almost glabrous: leaves lanceolate or oblong-lanceolate, narrowed at base, from irregularly denticulate to laciniate-toothed: scapes erect, 2 to 10 inches high: bracts of the small involucre subulate: lobes of the calyx mostly shorter than the tube: lobes of the corolla obovate, rather longer than the calyx. — High alpine to much lower, from New Mexico and Nevada to the Arctic coast

Var. *subulifera*, Gray. Lobes of the calyx slender-subulate, as long as the tube, surpassing the corolla. — Synopt. Fl. ii. 60. Mountains near Boulder City, Colorado, and San Bernardino, California.

+ + *Calyx-tube hemispherical in fruit; the short teeth barely greenish and rather shorter than the capsule.*

4. *A. filiformis*, Retz. Glabrous: leaves and scapes (1 to 4 inches high) nearly as in the preceding or more capillary: flowers less than a line and globose capsule only a line long: calyx-teeth broadly triangular, shorter than the very small corolla. — Mountains from Colorado and Utah to Wyoming.

5. STEIRONEMA, Raf.

Perennials, glabrous except the ciliate petioles: leaves all opposite, but mostly in seeming whorls on the flowering branches: flowers yellow.

1. *S. ciliatum*, Raf. Stem erect, 2 to 4 feet high, mostly simple: leaves ovate-lanceolate or oblong-ovate, gradually acuminate, 2 to 5 inches long, and mostly with a rounded or subcordate base, minutely ciliate; the long petioles hirsutely ciliate. — Gray, Proc. Am. Acad. xii. 62. *Lysimachia ciliata*, L. New Mexico to British Columbia and eastward across the continent.

2. *S. lanceolatum*, Gray. Stem erect, 1 to 2 feet high, simple or paniculately branched, somewhat angled: leaves lanceolate or linear, 1 to 2 inches long, tapering into a short and margined ciliate petiole or attenuated base; the radical and sometimes lowest cauline from oblong to orbicular, small: divisions of the corolla conspicuously erose and cuspidate-acuminate. — Proc. Am. Acad. xii. 62. *Lysimachia lanceolata*, Walt. The Dakotas and Nebraska to Louisiana and eastward.

Var. *hybridum*, Gray. Cauline leaves mostly petioled, from oblong to broadly linear. — Synopt. Fl. ii. 62. The commoner form westward.

6. GLAUX, Tourn. SEA-MILKWORT.

Flowers dimorphous. A low and leafy fleshy perennial.

1. *G. maritima*, L. Glabrous and glaucous or pale, perennial by slender running rootstocks: stems a span or less high, erect or spreading: leaves from oval to oblong-linear, $\frac{1}{4}$ to $\frac{1}{2}$ inch long, entire, sessile: calyx-lobes oval, purplish or white. — Salt marshes along both sea-coasts; also in subsaline soil in the interior west of the Mississippi.

7. CENTUNCULUS, Dill. CHAFFWEED.

Very small glabrous annuals, with mainly alternate leaves, and solitary inconspicuous flowers in their axils.

1. *C. minimus*, L. Stems ascending, 2 to 6 inches long: leaves ovate, obovate, or spatulate-oblong, contracted or tapering at base, all but the lowest sessile: calyx-lobes lanceolate-subulate. — From Illinois to Texas and westward to Oregon.

8. SAMOLUS, Tourn. BROOKWEED. WATER PIMPERNEL.

Low and glabrous herbs; with entire leaves, and small white flowers in simple or paniced racemes.

1. *S. Valerandi*, L., var. *Americanus*, Gray. Stem erect, slender, leafy, becoming diffusely branched: leaves obovate: racemes often paniced; bracts none; bractlets on the middle of the slender, spreading pedicels. — Wet places, across the continent.

ORDER 47. **OLEACEÆ.** (OLIVE FAMILY.)

Trees or shrubs, rarely almost herbaceous, with mostly opposite and pinnate or simple leaves, usually a 4-cleft (or sometimes obsolete) calyx, a regular 4-cleft or nearly or quite 4-petalous corolla, sometimes apetalous; the stamens generally 2, rarely 3 or 4; the ovary 2-celled, with one or two pairs of ovules in each cell.

- * Fruit entire, dry, indehiscent, winged (a samara): seed suspended: leaves pinnate.
- 1. **Fraxinus.** Flowers diœcious or polygamous, sometimes perfect. Calyx very small, 4-cleft or irregularly toothed, or entire, or wanting. Petals none, or 4 and either separate or united in pairs at the very base. Fruit by abortion mostly 1-celled and 1-seeded; the wing mainly terminal.
- ** Fruit fleshy and indehiscent (a drupe), not lobed: seed suspended or pendulous: leaves simple.
- 2. **Forestiera.** Flowers apetalous, diœcious or polygamous. Calyx minute, 4-parted or toothed, sometimes wanting. Drupe 1-seeded.
- *** Fruit a didymous or 2-parted at length membranaceous capsule, circumscissile at or near the middle: seeds ascending or erect: leaves mostly alternate and entire.
- 2. **Menodora.** Calyx 5 to 15-cleft, persistent; the lobes mostly linear. Corolla from rotate to salverform; limb 5 to 6-parted. Ovary emarginate, with 4 ovules in each cell. Seeds usually a pair in each cell, large, with a thickened and spongy outer coat.

1. **FRAXINUS**, Tourn. ASH.

Trees, with rather light tough wood, petioled odd-pinnate leaves of 3 to 15 toothed or entire leaflets, and small flowers in crowded panicles, which in ours are from the axils of last year's leaves. The oblong seed fills the cell of the samara or key-fruit. Ours are apetalous and diœcious, with a minute calyx or none, and the fruit winged only from the summit or upper part of the terete body, which tapers gradually from summit to base and is more or less margined upward by the decurrent wing.

1. **F. pubescens**, Lam. (RED ASH.) Tree of middle or large size: inner face of the outer bark of the branches red or cinnamon-color when fresh: *young parts velvety-pubescent*, commonly permanently so: *leaflets 7 to 9*, from ovate to oblong-lanceolate, mostly acuminate, entire or sparsely serrate or denticulate, *the lower face pale or whitish*, and *with the petioles more or less pubescent*: fruit $1\frac{1}{2}$ to 2 inches long; its body more than half the length of the linear or spatulate wing.—From the Dakotas to Canada and southward; quite rare within our range.

2. **F. viridis**, Michx. f. (GREEN ASH.) Small or middle sized tree, *glabrous*: leaflets 5 to 9, like the last, but smaller, sometimes more sharply serrate and *bright green both sides*, or barely pale beneath: fruit nearly as in the last or with a rather more decurrent wing.—From the Dakotas and Canada to Florida and Texas.

2. **FORESTIERA**, Poir.

Shrubs, with inconspicuous flowers, in early spring, from imbricated-scaly axillary buds, and small dark-colored drupes. Fascicles or panicles very

short, few-flowered; the staminate sessile and in a sessile globular scaly glomerule. Branches minutely warty.

1. **F. Neo-Mexicana**, Gray. Shrub 6 to 10 feet high, glabrous: leaves spatulate-oblong, obtuse or obtusely acuminate, short-petioled, obtusely or obsoletely serrulate, an inch long: fertile flowers in sessile fascicles: drupe obtuse, short-oblong or ovoid. — *Proc. Am. Acad.* xii. 63. S. Colorado to New Mexico and Texas.

3. MENODORA, Humb. & Bonpl.

Low shrubby or nearly herbaceous plants, with conspicuous yellow flowers terminating the branches, or becoming lateral. In ours the corolla is nearly rotate, with a bearded throat.

1. **M. scabra**, Gray. Herbaceous from a woody branching base, a span to a foot high, flax-like, whole herbage or at least the lower part puberulent-scabrous: leaves linear or the lower oblong, chiefly entire, 4 to 10 lines long: flowers rather numerous: calyx-lobes 7 to 15, slender, linear or subulate: lobes of the bright yellow corolla obovate, much longer than the tube. — *Am. Jour.* ci. ii. xiv. 43. W. Texas to S. Colorado and Arizona.

ORDER 48. APOCYNACEÆ. (DOGBANE FAMILY.)

Plants with milky or acrid juice, entire (mostly opposite) leaves, regular 5-merous and 5-androus flowers, the lobes of the corolla convolute and twisted in the bud, and the filaments distinct and inserted on the corolla. In ours the anther-cells are produced into a sterile appendage at base, connivent around the stigma and adherent to it by a point at the base of the polliniferous portion; the ovaries are 2 and united only by the common style or stigma, in fruit becoming follicles containing comose seeds.

1. APOCYNUM, Tourn. DOGBANE. INDIAN HEMP.

Calyx small, deeply 5-cleft, the tube by means of a thickish disk adnate to the back of the ovaries below. Corolla campanulate, 5-lobed, toward the base bearing 5 small triangular-subulate appendages alternate with the stamens. Filaments very short and broad: anthers sagittate. Follicles slender, terete. Seeds numerous, with a long coma at apex. — Pale perennial herbs, with very tough-fibrous bark and opposite mucronate-tipped leaves: flowers small, in terminal cymes, white or rose-color: follicles 2 to 7 inches long.

1. **A. androsæmifolium**, L. One to three feet high, glabrous, or rarely soft-tomentose, branched above; *branches widely spreading: leaves ovate or roundish, distinctly petioled: cymes loose, spreading: corolla flesh-color, open-campanulate with revolute lobes; the tube exceeding the ovate acute calyx-lobes.* — Across the continent.

2. **A. cannabinum**, L. Erect or ascending, glabrous or sometimes soft-pubescent: *branches ascending, leafy to the top: leaves from oval to oblong*

and even lanceolate, from short-petioled to sessile, with a rounded or obscurely cordate base: cymes erect, densely flowered: corolla greenish-white or slightly flesh-color, smaller than in the former, with almost erect lobes and tube not longer than the lanceolate calyx-lobes.—Same range as last. Exceedingly variable.

ORDER 49. ASCLEPIADACEÆ. (MILKWEED FAMILY.)

Plants with milky juice, and opposite or whorled (rarely scattered) entire leaves; general structure of flowers and fruit as in *Apocynaceæ*; but differing in the connection of the anthers with the stigma, the cohesion of the pollen into wax-like or granular masses, etc. A corona (crown), of 5 parts or lobes, between the corolla and filaments, is adnate either to the one or the other. The tube of monadelphous filaments is called the *column*. Ours all belong to the *Cynancheæ*, which have anthers tipped with an inflexed or sometimes erect scarious membrane; the polliniferous cells lower than the top of the stigma; and the pollinia suspended, attached in pairs (one of each adjacent cell of different anthers) to the corpuscle or gland.

* Hoods (the cucullate or hollowed nectariferous appendages of the crown) cristate- or coriuculate-appendaged within.

1. **Asclepiodora**. Corolla rotate-spreading in anthesis. Hoods basilar, inserted over the whole very short column, spreading and arcuate-assurgent, little surpassing the anthers, slipper-shaped and the rounded apex fornicate, hollow and with a thickish fleshy back, traversed by a salient crest which near the apex divides the cavity. Anther-wings narrowed at base, angulate above the middle if at all. Leaves commonly alternate.
2. **Asclepias**. Corolla almost always reflexed in anthesis. Hoods involute or complicate, not fornicate, bearing a horn or crest-like process from the back or toward the base within, either sessile next the corolla or elevated on a column which is shorter than the anthers. Anther-wings widening down to the base, usually triangular, the salient base being truncate or semi-hastate, or broadly rounded. Leaves opposite or varying to alternate or verticillate.

* * Hoods wholly destitute of crest or appendage within.

3. **Acerates**. Hoods involute-concave or somewhat pitcher-shaped. Anther-wings widened or angulate if at all near or above the middle, thence narrowed to the base. Otherwise as *Asclepias*. Leaves alternate or scattered.

1. ASCLEPIODORA, Gray.

Low and stout perennial herbs, often decumbent: flowers large: corolla lobes ovate, greenish: follicles usually bearing some scattered soft-spinulose projections, on recurved or sigmoid pedicels. Distinguished from *Asclepias* by the hood bearing a crest instead of a horn.—Proc. Am. Acad. xii. 66.

1. **A. decumbens**, Gray. Scabrous-puberulent: leaves from lanceolate to linear, tapering to the apex: umbel solitary: corolla depressed-globular in bud, hardly twice the length of the yellowish or dark-purplish hoods, which overtop the somewhat depressed anther-column: anther-wings salient, espe-

cially at the broader and strongly angulate upper portion: pollinia pear-shaped, short-caudicled. — *Proc. Am. Acad.* xii 66. *Acerates decumbens*, Decaisne. From Utah through S. Colorado and New Mexico to Texas and Arkansas.

2. ASCLEPIAS, L. MILKWEED. SILKWEED.

Herbs, from deep and thickish perennial roots: flowers umbellate; the peduncles terminal and lateral, usually between the petioles: follicles soft-echinate, warty or naked.

§ 1. *Hoods sessile, not attenuate at base; the horn or crest conspicuous: anther-wings broadest and usually angulate-truncate and salient at base.*

* *Corolla and hoods orange-color: follicles naked, erect on a deflexed pedicel: leaves mostly irregularly alternate, seldom opposite: juice of stem not milky.*

1. **A. tuberosa**, L. Hirsute or roughish-pubescent, 1 or 2 feet high, very leafy to the top: leaves from lanceolate-oblong to linear-lanceolate, sessile or slightly petioled: umbels several and mostly cymose at the summit of the stem: hoods narrowly oblong, erect, deep bright orange, much surpassing the anthers, almost as long as the purplish- or slightly greenish-orange oblong corolla lobes, nearly equalled by the filiform-subulate horn: follicles cinereous-pubescent. — From S. Colorado and Arizona to Texas, thence eastward to Florida and Canada. Known commonly as "Butterfly-weed" or "Pleurisy-root."

* * *Corolla and crown greenish, yellowish, white, or merely purplish-tinged: leaves opposite or sometimes whorled, or the upper rarely alternate or scattered.*

+ *Follicles echinate with soft spinous processes and densely tomentose, large (3 to 5 inches long) and ventricose, erect on deflexed pedicels: leaves large and broad, short-petioled, transversely veined: stems stout and simple, 2 to 5 feet high.*

2. **A. speciosa**, Torr. Finely canescent-tomentose: leaves from subcordate-oval to oblong, thickish: pedicels of the many-flowered dense umbel and the calyx densely tomentose: flowers purplish, large: corolla-lobes ovate-oblong: hoods spreading, the dilated body and its short inflexed horn not surpassing the anthers, but the centre of its truncate summit abruptly produced into a lanceolate-ligulate thrice longer termination: column hardly any: wings of the anthers notched and obscurely corniculate at base. — *Ann. Lyc. N. Y.* ii. 218. From Nebraska and Arkansas westward across the continent.

+ + *Follicles wholly unarmed and smooth throughout, either glabrous or tomentulose-pubescent.*

++ *Erect or ascending on deflexed or decurved pedicels.*

= *Umbel solitary on the perfectly simple strict stem, elevated on a naked terminal peduncle: leaves all closely sessile, broad, transversely veined.*

3. **A. obtusifolia**, Michx. Glabrous and pale or glaucous, 2 or 3 feet high: leaves undulate, oblong or elliptical, 3 to 5 inches long, with rounded or retuse apex and cordate-clasping base: peduncle 2 to 12 inches long:

umbel loosely many-flowered: corolla dull greenish-purple: column as high as broad: hoods flesh-color, erosely truncate and somewhat toothed at the broad summit, hardly exceeding the anthers, shorter than the falcate-subulate incurved horn: anther-wings bicorniculate at base.—From the Dakotas to Texas and eastward across the continent.

= = *Umbels mostly more than one: peduncle not overtopping the leaves, sometimes none.*

a. *Leaves broad (from orbicular to oblong-lanceolate), large: hoods broad, little if at all overtopping the anthers: stems stout, a foot or more in height.*

4. **A. Jamesii**, Torr. Puberulent when young, soon green and glabrous: leaves about 5 pairs, approximate, very thick and large, orbicular or broadly oval, often emarginate and with a mucro, subcordate at base, nearly sessile, copiously transversely veined: umbels 2 or 3, all or mostly lateral, densely many-flowered: flowers greenish: column very short but distinct: hoods barely equalling the anthers, broad, with a truncate entire summit, which is equalled by the upper margin of the falciform triangular crest, the apex of which extends into a short subulate horn partly over the top of the stigmatic disk.—Bot. Mex. Bound. 162. Plains of Colorado to Arizona and Texas.

5. **A. arenaria**, Torr. Lanuginous tomentose, in age glabrate: stems thickly leaved: leaves smaller, coriaceous when old, obovate or oval and retuse or the lower ovate, with rounded or subcordate base, somewhat undulate, distinctly petioled: umbels all lateral, rather densely many-flowered: corolla greenish white: column nearly half the length of the anthers: hoods about as broad as high, surpassing the anthers, truncate at base and summit, the latter oblique and notched on each side near the inner angle, which forms an obtuse tooth: horn with included ascending portion or crest broadly semilunate as high as the hood; the abruptly incurved apex subulate-beaked, horizontally exerted, or the slender termination ascending.—Bot. Mex. Bound. 162. On sandbanks, S. E. Colorado to New Mexico.

b. *Leaves narrow (lanceolate or linear), green, and nearly glabrous, the veins oblique: stems branching, a span or two high: hoods obtuse: column hardly any: follicles when young tomentose-canescant.*

6. **A. brachystephana**, Engelm. Stems 6 to 10 inches high, very leafy, cinereous-puberulent or tomentose when young, the inflorescence more floccose-tomentose: leaves from lanceolate with a broader rounded base to linear, short-petioled, very much surpassing the (3 to 8) few-flowered umbels: flowers lurid-purplish: hoods only half the length of the anthers, erect, strongly angulate-toothed at the front; the tip of the erect subulate horn exerted.—Torr. Bot. Mex. Bound. 163. Dry sandy soil, from Wyoming and Colorado to Arizona and Texas.

7. **A. uncialis**, E. L. Greene. Stems an inch or two high: flowers like the last, but the hoods only a little shorter than the anthers, the back rounder, and the triangular anterior lobes or auricles not projecting, while a short fleshy process takes the place of the subulate horn.—Bot. Gazette, v. 64. Wyoming, Colorado, and New Mexico.

c. *Leaves from ovate to oblong, mostly pubescent or puberulent: stems a foot or more high: hoods obtuse, 2 or 3 times the length of the anthers, not tapering to*

base, entire at summit, involute-concave; the falcate or subulate horn free at or below the middle of the horn, and incurved or inflexed over the stigmatic disk.

8. **A. ovalifolia**, Decaisne. Tomentulose-pubescent: stem rather slender: leaves thinish, from ovate or oval to ovate lanceolate, mostly acute, rounded at base, distinctly petioled, the midrib and veins slender, the veinlets reticulated: umbels few, loosely 10 to 13-flowered, on peduncles which seldom equal the pedicels: corolla greenish-white with purplish outside: hoods oval or broadly oblong in outline, not auriculate at base, the inner margins below the middle extended into a large acute tooth or lobe; the horn broad and rather short: anther-wings rounded and mostly entire. — From the Dakotas to the Saskatchewan and N. Illinois.

9. **A. Hallii**, Gray. Puberulent-glabrate: stem stout: leaves thickish, ovate-lanceolate or oblong-lanceolate with rounded base and rather acute apex, short-petioled, the stout midrib and straight veins prominent underneath: umbels few and corymbose, many-flowered, on peduncles somewhat longer than the pedicels: corolla greenish-white and purplish: hoods elongated-oblong in outline, entire, hastately 2-gibbous above the narrower base, a little surpassing the sickle-shaped horn: anther-wings unappendaged at base. — Proc. Am. Acad. viii. 69. *A. ovalifolia* of Fl. Colorado, 114. Colorado.

++ ++ Follicles erect on erect pedicels: leaves usually verticillate, filiform, glabrous.

10. **A. verticillata**, L. Stems a foot or two high, slender, very leafy: leaves mostly in whorls of 3 to 6, or some scattered, filiform-linear, with revolute margins: umbels numerous, small, many-flowered, on peduncles longer than the pedicels: corolla greenish-white: hoods white, broadly ovate and entire, with somewhat auriculate involute base, barely equalling the anthers, much shorter than their elongated-subulate falcate-incurved horn. — In dry soil, from New Mexico and Colorado to Nebraska, and eastward across the continent.

Var. **pumila**, Gray. A span or more high, many-stemmed from a fascicled root: leaves much crowded, filiform: peduncles seldom longer than the pedicels. — Proc. Am. Acad. xii. 71. From New Mexico to Nebraska and Kansas.

§ 2. *Anther-wings widening to the broadly rounded base and conspicuously auriculate-notched just above it: hoods sessile, with a narrow wholly adnate internal crest terminating in a minute horn: pollinia short and thick, arcuate-obovate.*

11. **A. stenophylla**, Gray. Puberulent, but foliage glabrous: stems slender, 1 or 2 feet high, simple: leaves long and narrowly linear, with scabrous and more or less revolute margins and a strong midrib; the upper alternate and the lower opposite: umbels several, 10 to 15 flowered: flowers greenish: hoods whitish, erect, equalling the anthers, conduplicate-concave, the base of each inner margin appendaged by a cuneate closely truncate lobe, the apex 2-lobed and the narrow internal crest exerted in the sinus in the form of an intermediate tooth: interior crown of 5 very small 2-lobed processes between the bases of the anthers: follicles long-acuminate, erect on the ascending pedicel. — Proc. Am. Acad. xii. 72. *Acerates angustifolia*, Decaisne. From Colorado and N. Texas to Nebraska and W. Arkansas.

3. ACERATES, Ell. GREEN MILKWEED.

Perennial herbs, resembling *Asclepias*, but distinguished by the total absence of horn or crest to the hoods. Flowers small, greenish or barely tinged with purple.

* *Mass of anthers and stigma globular, not equalled by the hoods: column below the hoods evident: leaves mainly alternate-scattered, very numerous.*

1. **A. auriculata**, Engelm. Glabrous up to the inflorescence: stem 2 or 3 feet high, slender: leaves linear-filiform, with scabrous margins: umbels several, lateral: column below the hoods very short: hoods oval or quadrate, emarginately or sometimes 3-crenately truncate, the involute margins at base appendaged with a pair of remarkably large and broad auricles: anther-wings narrow and of equal breadth from top to bottom. — Bot. Mex. Bound. 160. From Colorado to New Mexico and S. Texas.

* * *Mass of anthers and stigma longer than broad, almost equalled by the hoods, the short insertion of which covers the very short column: leaves often opposite, mostly broader.*

2. **A. viridiflora**, Ell. Tomentose-puberulent: stem 1 or 2 feet high: leaves oval or oblong and obtuse or retuse, or sometimes narrower and acute: umbels 2 to 5 or sometimes solitary, dense, mostly lateral and subsessile: pedicels little over twice the length of the reflexed narrowly oblong lobes of the greenish corolla: hoods somewhat fleshy, with small auricles at base much involute and concealed, alternated by as many short and roundish or gland-like small internal teeth: anther-wings semi-rhomboid above, with a much longer tapering base. — From Colorado to the Saskatchewan and eastward across the continent.

3. **A. lanuginosa**, Decaisne. Hirsute rather than woolly: stems a span or two high, terminated by a single pedunculate umbel: leaves frequently alternate or scattered, from oblong-ovate to lanceolate, with roundish base: pedicels 3 or 4 times the length of the oblong lobes of the greenish corolla: hoods purplish, obtuse and entire, involute auricles at base obscure if any: the alternating internal teeth or lobes small and emarginate: anther-wings broadest and obtusely angulate below the middle. — From the head-waters of the Missouri to Wisconsin and N. Illinois.

ORDER 50. GENTIANACEÆ. (GENTIAN FAMILY.)

Smooth herbs, with a colorless bitter juice, opposite and sessile entire and simple leaves without stipules, regular flowers with the stamens as many as the lobes of the corolla, a one-celled ovary with two parietal placentæ, or nearly the whole ovary wall ovuliferous; the fruit a many seeded capsule. Flowers cymose or simply terminal. In all ours the lobes of the corolla are convolute in the bud.

* Style distinct and slender, deciduous: anthers twisting in age.

1. **Erythraea**. Parts of the flower 5 or 4. Corolla salverform. Anthers oblong or linear, commonly exserted, twisting spirally in one or two turns after anthesis. Capsule from oblong-ovate to fusiform.

* * Style short and persistent, or none: anthers remaining straight.

← Corolla without nectariferous pits or large glands.

2. **Gentiana.** Calyx commonly with a membranous tube. Corolla funnelform, campanulate, or salverform; the sinuses with or without plaits or appendages. Stamens on the tube of the corolla. Style very short or none. Seeds very numerous, not rarely covering the inner wall of the ovary.
3. **Pleurogyne.** Calyx deeply 4 to 5-parted. Corolla rotate, 4 to 5-parted; the divisions acute, a pair of scale-like appendages on their base. Stamens on the base of the corolla. Style none: stigmas decurrent down the sutures. Seeds extremely numerous, near the two sutures.
- ← ← Corolla with one or two nectariferous pits, spots (glands), or an adnate scale to each lobe: calyx 4 to 5-parted.
4. **Swertia.** Corolla rotate, 5- (rarely 4-) parted. Style none or very short. Capsule ovate. Leaves sometimes alternate.
5. **Frasera.** Corolla rotate, 4-parted; the lobes bearing a single or double fringed gland, and sometimes a fimbriate crown at base. Stamens on the very base of the corolla: filaments often monadelphous at base. Capsule coriaceous, commonly flattened. Leaves verticillate or opposite.

1. ERYTHRÆA, Renealm. CENTAURY.

Low herbs: the flowers usually small and with broad stigmas.

1. **E. Douglasii**, Gray. Slender, a span to a foot high, loosely and paniculately branched, usually sparsely flowered: leaves from oblong to linear, mostly acute: flowers all on strict and slender peduncles or pedicels: lobes of the pink corolla oblong, obtuse, at most 2 lines long, nearly half the length of the tube.—Bot. Calif. i. 480. Wyoming to Utah and westward to California and Oregon.

2. GENTIANA, Tourn. GENTIAN.

Herbs, with conspicuous flowers of various colors, in summer or autumn. Herbage and roots very bitter.

§ 1. *Corolla destitute of extended plaits or lobes or teeth at the sinuses.* — GENTIANELLA.

* *Flowers large or middle-sized, solitary, mostly 4-merous: corolla campanulate-funnelform, its lobes usually fimbriate or erose, not crowned: a row of glands between the bases of the filaments.* (FRINGED GENTIANS.)

← *Flower on a naked and usually long peduncle terminating the stem or branches, not bracteate at base: filaments naked: calyx with acutely carinate lobes, the tube sharply angled by the decurrent keels.*

1. **G. crinita**, Frœl. A foot or two high, often paniculate-corymbose, leafy: leaves lanceolate or ovate-lanceolate from a rounded or subcordate partly clasping base: corolla 2 inches long, sky-blue, rarely white; its lobes cuneate-obovate, strongly fimbriate around the summit, less so down the narrowing sides: capsule conspicuously stipitate.—Head-waters of the Missouri to Canada, thence southward to Georgia.

2. **G. serrata**, Gunner. Stem 3 to 18 inches high: leaves linear or lanceolate-linear: corolla 1 to 1½ inches long, sky-blue or rarely white; its lobes oblong or spatulate-obovate, erosely fimbriate or toothed around the summit and sides, or sometimes either part nearly bare: capsule short-stipitate. — *G. detonsa*,

Fries. From Nevada to Colorado, the Saskatchewan, and northward, thence eastward to New York and Canada.

+ + *Flower 2-bracteate under or near the calyx: filaments ciliate-bearded below the middle: calyx hardly at all angled or carinate.*

3. **G. barbellata**, Engelm. Stems single or in pairs from the slender fusiform root or caudex, 2 to 5 inches high: leaves rather thick and fleshy, obtuse, with roughish callous margins; the radical spatulate or slender-petioled; the 2 or 3 cauline pairs spatulate-linear, or the uppermost narrowly linear and connate at base: corolla bright blue, 1 to 1½ inches long, twice the length of the calyx; the lobes oblong, erose-denticulate above, conspicuously fringed along the middle: capsule not stipitate. — Trans. St. Louis Acad. ii. 216. Alpine region of the Colorado mountains.

* * *Flowers smaller, 4 to 5-merous: corolla somewhat funnelform or salverform when expanded; the lobes entire, their base mostly crowned with setaceous filaments: capsule seldom stipitate.*

+ *Peduncles elongated and naked from a very short stem, one-flowered.*

4. **G. tenella**, Rottb. An inch to a span high: leaves oblong or the lowest spatulate: calyx deeply 5- (or 4-) parted: corolla 2½ to 4 lines long, double the length of the calyx, blue; its lobes ovate-oblong, rather obtuse, little shorter than the tube: fimbriate crown conspicuous at the throat. — High alpine regions in Colorado and northward to the arctic regions.

+ + *Peduncles short or none, terminal and lateral on a comparatively elongated stem.*

5. **G. heterosepala**, Engelm. A span or two high, racemosely few-flowered: leaves ovate-lanceolate or oblong: calyx very unequally 5-parted; two of the lobes large and foliaceous, ovate, acute, equalling the tube of the pale blue corolla (4 to 6 lines long); the other three linear-subulate and shorter: setæ of the crown copious, united below into a membrane on the base of each corolla lobe. — Trans. St. Louis Acad. ii. 215. In the mountains of New Mexico, Colorado, and Utah.

6. **G. Amarella**, L. From 2 to 20 inches high: leaves from lanceolate to narrowly oblong, or the lowest obovate-spatulate: calyx 5-cleft below the middle; the lobes lanceolate or linear, equal or one or two of them longer, all shorter than the mostly blue corolla, which is ½ inch or more long.

Var. acuta, Hook. f. Calyx almost 5-parted: crown usually of fewer and sometimes very few setæ. — *G. Amarella* of the Western Reports. Throughout British America and southward along the mountains to New Mexico and California.

Var. stricta, Watson. Stem (sometimes 2 to 4 feet high) and branches strict, remotely leafy: leaves thickish, the cauline lanceolate-linear: flowers numerous, commonly 4-merous, smaller: calyx less deeply cleft: corolla whitish, little longer than the unequal calyx; setæ of the crown sometimes very few or even wanting. — Bot. King's Exped. 278.

§ 2. *Corolla plicate at the sinuses, the plaits more or less extended into thin-membranaceous teeth or lobes: no crown nor glands.* — PNEUMONANTHE.

* *Dwarf: leaves small and with white cartilaginous or scarious margins: flowers solitary and terminal: calyx narrow, 4 to 5-toothed: corolla salverform when*

expanded; the lobes or plaits in the sinuses broad and emarginate: anthers cordate.

7. *G. humilis*, Stev. Stems single or numerous, 1 to 5 inches long, erect or ascending: leaves glaucescent and broadly white-margined; the radical orbicular or ovate and rosulate; cauline linear-oblong, erect, connate-sheathing, 2 or 3 lines long: corolla whitish or dull-colored; its tube little exceeding the calyx; the limb $\frac{1}{2}$ inch in diameter: capsule clavate-obovate, at length exerted on a long and stout stipe much beyond the flower. — Grassy banks in the mountains from Colorado to Wyoming.

8. *G. prostrata*, Hænke. Stems weaker than in the preceding, and when elongated the lateral ones often procumbent: leaves ovate, less erect, greener, and less white-margined: flower 4-merous: corolla azure-blue, in fruit enclosing the linear-oblong rather short-stipitate capsule. — Alpine regions from Colorado northward.

* * Flowers comparatively large, mostly short-peduncled or sessile: anthers linear or oblong: usually a pair of bracts under the flower.

+ Dwarf, 1 to 3-flowered: cauline leaves only 2 to 4 pairs.

9. *G. frigida*, Hænke. Stems 1 to 5 inches high: leaves linear, varying to lanceolate or spatulate, thickish, the pairs connate-sheathing at base: calyx-tube obconical: corolla funnelform, $1\frac{1}{2}$ inches long, yellowish white or tinged with blue, purplish-dotted; the lobes short and broad; the plaits entire and broad but slightly extended at summit. — Including var. *algida*, Pall. Alpine regions of Colorado, Utah, and northward.

+ + Low: stems several from the same caudex: cauline leaves 6 to 16 pairs, more or less connate or even sheathing at base; the uppermost involucrate around the sessile terminal flower or 3 to 5-flowered cluster: corolla blue, 1 to $1\frac{1}{2}$ inches long; the lobes broadly ovate, and the appendages at the sinuses 2-cleft or lacerate.

10. *G. calycosa*, Griseb. A span or more high: leaves ovate; the lowest pairs usually smaller and with connate-sheathing base, the upper hardly so; the involucrate uppermost leaves somewhat exceeding the calyx of the commonly solitary flower: calyx lobes ovate or oblong, or even subcordate, about the length of the tube: corolla oblong-funnelform, its appendages in the sinuses triangular-subulate, lacinate, or 2-cleft at the tip. — California and Oregon to Montana, Wyoming, and northward.

11. *G. Parryi*, Engelm. A span or more high: leaves glaucescent, thickish, ovate, varying to oblong-lanceolate, most of the pairs with a somewhat sheathing base; the involucrate uppermost 2 or 3 concealing the calyx and sometimes almost equalling the corolla of the 1 to 5 flowers: lobes of the calyx short-linear, more or less shorter than the tube: appendages at the sinuses of the corolla narrow, deeply 2-cleft. — Trans. St. Louis Acad. ii. 218. Alpine and subalpine regions of New Mexico, Colorado, Utah, and Nevada.

+ + + Stems rather taller, many-leaved: flowers not involucrate: the lacinate-toothed or cleft appendages at the sinuses of the corolla sometimes almost equalling the lobes.

12. *G. affinis*, Griseb. Stems clustered, a span or more high: leaves from oblong or lanceolate to linear: flowers from numerous and thyrsoid-racemose to few or rarely almost solitary: bracts lanceolate or linear: calyx-

lobes linear or subulate, unequal and variable, the longest rarely equalling the tube, the shorter sometimes minute: corolla an inch or less long, rather narrowly funnel-form; its lobes ovate, acutish or mucronulate-pointed, spreading. — From the mountains of New Mexico and California to British Columbia and the Saskatchewan.

13. *G. Bigelovii*, Gray. Very similar to the last, but the corolla is oblong, with shorter lobes, and bears salient crenulate or roughened ridges which in the bud externally border the infolded plicæ: the stipe is shorter and broader and completely fistulous. — Proc. Am. Acad. xix. 87. *G. affinis* in part. Colorado to Arizona.

14. *G. Forwoodii*, Gray. Resembling *G. affinis*, but the corolla decidedly smaller ($\frac{3}{4}$ inch long), narrow, and with shorter and rounder lobes, these little surpassing the plical appendages: stems 6 to 12 inches high and equably leafy to the very top: calyx subcampanulate, with no vestige of lobes or teeth. — Proc. Am. Acad. xix. 86. High meadows of the Wind River Mountains, Wyoming.

3. PLEUROGYNE, Eschsch.

Small annuals of cold regions, with blue or whitish flowers, and distinguished by the remarkable decurrent stigmas.

1. *P. rotata*, Griseb. Stems 2 to 10 inches high, the smaller simple and 1-flowered; the larger either simple and racemously several-flowered or fastigiate much branched: leaves linear or lanceolate, or the radical ones short and spatulate: sepals similar to the upper leaves: lobes of the corolla bearing at base a pair of glandular and scale-like processes. — In subalpine regions of Colorado and northward throughout British America.

4. SWERTIA, L.

Simple-stemmed perennials, occasionally with alternate leaves, the lower tapering into a margined petiole: inflorescence thyrsoid: flowers blue, varying to white.

1. *S. perennis*, L. A span or more high: lowest leaves oblong or obovate-spatulate (2 to 4 inches long); upper cauline few and narrower, sessile: inflorescence racemiform or narrowly paniculate, few to many-flowered: sepals narrowly lanceolate: lobes of the corolla bearing at base a pair of nectariferous pits which are crested with a fringe. — Colorado, Utah, and northward.

5. FRASERA, Walt.

Large and stout herbs; with single erect stem from a thick bitter root, the broader leaves commonly nervose, inflorescence thyrsoid with copious flowers and dark-dotted corolla.

1. *F. speciosa*, Dougl. Stem 2 to 5 feet high, very leafy: leaves in 4's and 6's; the radical and lowest cauline obovate or oblong, 6 to 10 inches long; the upper lanceolate and at length linear: flowers very numerous in a long leafy thyrsus: lobes of the greenish-white or barely bluish and dark-dotted corolla oval-oblong, bearing a pair of contiguous and densely long-fringed glands about the middle, and a distant transversely inserted and setaceous multifid scale-like crown near the base. — In the mountains from Wyoming to Oregon, and southward to New Mexico and California.

ORDER 51. **POLEMONIACEÆ.** (POLEMONIUM FAMILY.)

Herbs, with alternate or opposite leaves, regular 5-merous and 5-
audrous flowers, the lobes of the corolla convolute in the bud, a 3-celled
ovary and a 3-lobed style: the pod few to many-seeded, its 3 valves
usually breaking away from the central column.

1. **Phlox.** Corolla strictly salverform, with slender tube and narrow orifice. Stamens
unequally inserted on the tube of the corolla: filaments very short: anthers mostly
included. Leaves opposite and entire.
2. **Gilia.** Corolla from campanulate to funnelform or salverform, with an open orifice.
Stamens equally or unequally inserted: filaments not declined, naked at base. Leaves
various.
3. **Polemonium.** Corolla from funnelform to nearly rotate. Stamens equally inserted:
filaments more or less declined and usually pilose-appendaged at base. Leaves all
alternate, pinnate or pinnately parted.

1. **PHLOX**, L. PHLOX.

Cauline leaves sessile and opposite, or some of the upper alternate: flowers
cymose, showy, and variously colored. Our Rocky Mountain forms are some-
what suffrutescent, chiefly with narrow or minute and thickish-margined
leaves, and branches or peduncles mostly one-flowered.

* *Densely cespitose and depressed, mostly forming cushion-like evergreen mats or
tufts: the short leaves crowded up to the solitary and usually sessile flowers,
and also fascicled.*

← *Leaves more or less beset or ciliate with cobweb-like or woolly hairs,*

++ *Very short, broadish or scale-like, soft, barely mucronate, appressed-imbricated:
plants very depressed, moss like, forming pulvinate tufts: lobes of the corolla
entire.*

1. **P. bryoides**, Nutt. *Copiously lanate: leaves very densely appressed-
imbricated in 4 strict ranks on the loosely tufted branches, scale-like, ovate-
or triangular-lanceolate, minute ($1\frac{1}{2}$ lines long), with rather inflexed mar-
gins: tube of the corolla considerably longer than the calyx; its cuneate lobes
barely $1\frac{1}{2}$ lines long.* — Pl. Gamb. 153. Alpine summits in Wyoming and
northward.

2. **P. muscoides**, Nutt. *Like the preceding, more resembling some canes-
cent moss: the branches much tufted, very short: leaves less strictly 4-ranked
and less lanate, ovate-lanceolate: tube of the corolla not surpassing the calyx.* —
Jour. Acad. Philad. vii. 42. Mountains at the sources of the Missouri.

++ ++ *Leaves subulate or acerose, somewhat rigid, less appressed: plants forming
broad mats 2 to 4 inches high.*

3. **P. Hoodii**, Richards. *Sparsely or loosely lanate, becoming glabrate:
leaves rather rigid, erect, somewhat loosely imbricated: tube of the (white?)
corolla not exceeding the calyx; its lobes obovate, entire.* — From the mountains
of S. W. Wyoming northward.

4. **P. canescens**, Torr. & Gray. More lanate and canescent: *leaves imbricated, soon recurved-spreading above the appressed base: tube of the white corolla at length exceeding the calyx; the obovate lobes entire or emarginate.*—Pacif. R. Rep. ii. 8. From Wyoming and Colorado to the mountains of New Mexico and California.

+ + *Leaves rigid, destitute of woolly or cobwebby hairs, the margins naked or ciliate with rigid or rather soft hairs: plants either densely or loosely tufted: the leaves mostly less crowded.*

5. **P. cæspitosa**, Nutt. *Leaves linear-subulate or oblong-linear, commonly much crowded, hispid-ciliate, otherwise glabrous or with some short glandular-tipped hairs: corolla with tube somewhat exceeding the calyx.*—Jour. Acad. Philad. vii. 41. Mountains of Colorado, Montana, and westward. Occurs under several dwarfed forms.

6. **P. Douglasii**, Hook. *Less densely tufted; either pubescent or nearly glabrous: leaves acrose or narrowly linear subulate, less rigid and usually less crowded, often spreading, their margins hirsutely ciliate next the base or naked: flowers subsessile or short-peduncled: corolla (purple, lilac, or white) with tube exceeding the calyx.*—From Montana to Utah, Colorado, and westward.

Var. **longifolia**, Gray. A rigid form, of more arid regions, and *long and narrow less fascicled leaves.*—Proc. Am. Acad. viii. 254. W. Nebraska to Oregon and California.

* * *Loosely tufted or many-stemmed from a merely woody-persistent base, with linear or lanceolate spreading leaves, which are little if at all fascicled in the axils: flowers slender-peduncled.*

7. **P. longifolia**, Nutt. *Nearly glabrous or pubescent, much branched or many-stemmed, 3 to 8 inches high: leaves mostly narrowly linear, 1 to 2½ inches long: calyx more or less angled by the white-membranaceous replicate sinuses: lobes of the rose-colored or white corolla obovate- or oblong-cuneate, entire or retuse: style long and slender.*—Jour. Philad. Acad. vii. 41. From Colorado to Montana and westward.

Var. **brevifolia**, Gray. A depressed or dwarf form; with *leaves 3 to 4 lines long, rigid and with more cartilaginous margins, at least the lower lanceolate or ovate-lanceolate.*—Proc. Am. Acad. viii. 254.

8. **P. nana**, Nutt. *Glandular and roughish-pubescent, loosely and copiously branching, a span or more high: leaves linear, 1 to 2 inches long, those of the branches often alternate: flowers scattered or somewhat corymbose: calyx not at all angled: lobes of the rose-red or white corolla ample and broadly cuneate-obovate or roundish, entire or nearly so: style very short.*—Pl. Gamb. 153. From S. Colorado to New Mexico and Texas.

2. GILIA, Ruiz & Pav.

A large and variable genus, broken up into many ill-defined sections, which are sometimes considered genera. Includes *Collomia*, Nutt., formerly separated by its unequally inserted stamens and solitary ovules, but both characters have failed.—Gray, Proc. Am. Acad. viii. 261; Ibid. xvii. 223, foot-note.

A. *Stamens usually unequally inserted: leaves mostly alternate, and pinnately incised or divided: seed-coat usually developing spiral threads when wetted.*

* *Leaves sessile and entire: ovules solitary: more or less viscid-pubescent or glandular plants.*

1. **G. linearis**, Gray. Branching and in age spreading, a span or two high: flowers capitate-crowded and leafy-bracted: calyx obconical; its lobes triangular-lanceolate: corolla from lilac-purple to nearly white, very slender. — Proc. Am. Acad. xvii. 223. *Collomia linearis*, Nutt. From Colorado and California northward throughout British America.

2. **G. gracilis**, Hook. At length corymbosely much branched and spreading, 2 to 6 inches high: leaves lanceolate or linear or the lowest oval or obovate: flowers rather loosely cymose or scattered: calyx rounded at base; its lobes subulate-linear: corolla purple or violet; its narrow tube yellowish: the mucilage-cells of the seed-coat wholly destitute of spiracles! — *Collomia gracilis*, Dougl. From Arizona and New Mexico northward through Colorado to British Columbia.

* * *Cauline leaves very numerous, simply pinnately parted into narrowly linear divisions: inflorescence thyrsiform or paniced: ovules numerous in each cell: slightly if at all viscid plants.*

3. **G. longiflora**, Don. Glabrous, loosely paniculate-branched: divisions of the leaves long and slender: flowers somewhat corymbose on slender peduncles: corolla white, strictly salverform, showy; the tube often $1\frac{1}{2}$ inches long, with narrow orifice; lobes orbicular or ovate. — *Collomia longiflora*, Gray. W. Nebraska and Colorado to Texas and Arizona.

4. **G. aggregata**, Spreng. Somewhat pubescent: stems 2 to 4 feet high, leafy, sometimes loosely branching: leaves thickish, with narrowly linear mucronulate divisions: thyrsoid narrow panicle loose or interrupted; the flowers sessile in small mostly short-pedunculate clusters: calyx commonly glandular: corolla from scarlet to pink-red (rarely white), with narrow tube; the lobes ovate or lanceolate, acute or acuminate, widely spreading, soon recurved. — *Collomia aggregata*, Porter. From W. Nebraska to Oregon, and southward to California, New Mexico, and W. Texas.

Var. **attenuata**, Gray. Corolla-lobes lanceolate, tapering gradually from the very base into a slender acumination: calyx-lobes equally slender. — Synopt. Fl. ii. 145. Middle Park, Colorado.

B. *Stamens equally inserted: seed-coat sometimes developing spiral threads.*

* *Leaves either opposite or palmately divided, or both; their divisions from narrowly linear to filiform.*

+ *Leaves opposite: flowers small, in a head or dense cluster.*

5. **G. nudicaulis**, Gray. Very glabrous, an inch to a span high, at length branching from the base: stem leafless from the cotyledons up to the inflorescence, which is a close head or glomerule subtended by an involucre of several entire ovate-lanceolate or lanceolate foliaceous bracts: corolla salverform, white, pink, or yellow; the tube 3 or 4 lines long and thrice the length of the calyx: ovules 10 to 16 in each cell. — Proc. Am. Acad. viii. 266. Sandy plains, from Colorado to Nevada and Oregon. In spring.

6. **G. Nuttallii**, Gray. *Cinereous-puberulent* or the leaves glabrate, more or less woody at base: stems or branches a span to a foot high, terminated by a dense leafy cluster of flowers: *leaves 3 to 7 parted*: the divisions narrowly linear, mucronate: corolla white with a yellow more funnellform throat: *the tube not longer than the calyx*: *ovules a pair in each cell*.—Proc. Am. Acad. viii. 267. Mountains of Colorado and Utah to Arizona and the Sierras of California.

+ + *Leaves all alternate and much fascicled in the axils: flowers showy, solitary or few in a cluster at the summit of the branches.*

7. **G. pungens**, Benth. Stems woody, tufted, very leafy: branches and mostly erectish or little spreading leaves viscid-pubescent, puberulent, or glabrate: leaves 3 to 7-parted, acerose or subulate, rigid and pungent: corolla rose or white: ovules 8 or 10 in each cell.—From the Upper Platte and Columbia to Arizona and California.

Var. **cæspitosa**, Gray. A low and dense form, imitating *Phlox Douglasii* in growth.—Proc. Am. Acad. viii. 267. Scott's Bluffs, Wyoming.

* * *Leaves alternate and pinnately incised, cleft, or divided (rarely entire), occasionally some of the lowermost opposite.*

+ *Flowers capitate-clustered, leafy bracted; bracts and calyx-lobes acerose-pungent or cuspidate.*

+ + *Calyx lobes and the mostly multifid bracts rigid and acerose-pungent: leaves, at least some of them, more than once pinnately-parted.*

8. **G. intertexta**, Steud. *Erect or widely branched, low and rather stout, neither viscid nor glandular: stem retrorsely pubescent: leaves mainly glabrous, with divaricate acerose-spinescent divisions sparingly divided or simple: flowers densely glomerate: tube of the calyx and base of the bracts strongly villous with white spreading hairs; its lobes equalling the white corolla (3 or 4 lines long): ovules and seeds 3 or 4 in each cell*.—From the Rocky Mountains westward to California and Oregon.

9. **G. minima**, Gray. *Depressed, often forming broad tufts, $\frac{1}{2}$ to 2 inches high, glabrate: leaves acicular and with simpler and fewer divisions than the preceding: tube of the calyx white-hairy in the broad sinuses, as long as the unequal lobes, which equal or exceed the white corolla ($1\frac{1}{2}$ lines long): ovules 1 to 3 in each cell*.—Proc. Am. Acad. viii. 269. In very dry regions from the Dakotas to Colorado and Oregon.

10. **G. Breweri**, Gray. *Erect or at length much branched and diffusely spreading, an inch to a span high, very minutely glandular-puberulent all over: flowers less glomerate: leaves with mostly simple acicular-subulate divisions: calyx-lobes similar to these, narrowly subulate, about equalling the yellow corolla (3 or 4 lines long), 3 or 4 times the length of the tube: ovules 1 or 2 in each cell*.—Proc. Am. Acad. viii. 269. From Wyoming to Utah, Nevada, and California.

+ + *Calyx-lobes and bracts cuspidate but not pungent: leaves simply pinnatifid or entire.*

11. **G. spicata**, Nutt. *Stems rather stout, erect, simple, or several from the fusiform root, a span or two high: capitate flower-clusters crowded in an elongated virgate and spike-like thyrsus: leaves thickish, almost filiform, some*

about 3-cleft, occasionally all entire, barely mucronate: corolla-lobes shorter than the tube: anthers subsessile in the throat: ovules 4 to 6 in each cell. — Mountains of Colorado, to Utah and Wyoming.

Var. **capitata**, Gray. A dwarf form: leaves nearly all entire: thyrsus short and capituliform: filaments as long as the anther. — Alpine region, from the Black Hills of South Dakota to Colorado.

12. **G. congesta**, Hook. Stems erect or spreading, 3 to 12 inches high, from a tufted base, bearing single terminal or few and corymbose capituliform cymes: leaves with 3 to 7 mucronate divisions, or some of them entire: lobes of the corolla nearly as long as the tube, which does not exceed the usually aristulate-tipped calyx-lobes: exerted filaments at length as long as the anthers: ovules 2 to 4 in each cell. — From Wyoming and Colorado to Oregon and California.

Var. **crebrifolia**, Gray. Depressed; the tufted stems 2 or 3 inches long, crowded with small entire leaves, and terminated by a single capitate cluster. — Mountains of Colorado and Utah.

13. **G. iberidifolia**, Benth. Leaves more rigid and the lobes cuspidate-tipped, as also the bracts: capitate cymes corymbose: filaments shorter: ovules solitary in each cell. — North Platte, Wyoming, and Nebraska.

14. **G. pumila**, Nutt. About a span high: stems loosely woolly, at least when young, leafy: leaves narrowly linear, entire or most of them 2 to 4-parted into diverging linear lobes, mucronate: flowers cymulose-glomerate and leafy-bracted: tube of the corolla slender, about twice the length of the aristulate-tipped calyx-lobes: filaments slender, inserted in the sinuses, exerted, shorter than the lobes of the corolla: ovules about 6 in each cell. — From W. Nebraska to W. Texas and west to the Sierra Nevada.

15. **G. polycladon**, Torr. About a span high: stems puberulent or sparsely pubescent, diffuse, very few-leaved: leaves pinnatifid or incised; the lobes short, oblong, abruptly spinulose-mucronate, those subtending the cymose cluster longer than the flowers: flowers cymulose-glomerate and leafy-bracted: tube of the corolla hardly exceeding the aristulate-mucronate calyx-lobes: anthers in the throat, on very short filaments: ovules 2 in each cell. — Bot. Mex. Bound. 147. W. Texas to Utah and Nevada.

+ + Flowers thyrsoid-paniculate, inconspicuously bracted or ebracteate, never yellow, ovules 6 in each cell.

+ + Corolla rose-red: anthers subsessile in the throat.

16. **G. Haydeni**, Gray. Almost glabrous, slightly glandular above, a span or more high, effusely much branched, somewhat corymbose: radical leaves pinnatifid; those of the branches linear and subulate, bract-like, entire: calyx-lobes subulate, shorter than the tube: corolla-tube $\frac{1}{2}$ inch long, several times longer than the obovate lobes. — Proc. Am. Acad. xii. 79. On the San Juan in S. W. Colorado or adjacent Utah, Brandegee.

+ + Corolla bluish or white: filaments slender and much exerted.

17. **G. stenothyrsa**, Gray. Stem simple, virgate, very leafy up to the racemiform narrow thyrsus: leaves pinnately cleft into short oblong lobes: bracts small and entire: stamens moderately exerted: corolla somewhat funnelform, white, nearly $\frac{1}{2}$ inch long. — Proc. Am. Acad. viii. 276. Uinta Mountains, Fremont.

18. **G. pinnatifida**, Nutt. Stem simple or loosely branching, a span to 2 feet high: *inflorescence open-paniculate, often compound: leaves pinnately parted into linear or narrowly oblong lobes; these sometimes again 1 or 2-lobed: stamens conspicuously exerted: corolla strictly salverform, 2 or 3 lines long, pale blue or violet, or the narrow tube white.*—Proc. Am. Acad. viii. 276. In the mountains from S. Wyoming through Colorado to New Mexico.

+ + + *Flowers scattered or somewhat crowded, occasionally yellow: ovules one to many in each cell.*

++ *Corolla very small (2 lines or less), salverform, white: leaves filiform, entire, or sometimes 3-parted: ovules solitary in the cells: not viscid-glandular.*

19. **G. minutiflora**, Benth. *Glabrous, or minutely glandular-puberulent above: stem erect, a foot or two high, with many virgate and rigid slender branches: upper leaves all reduced to minute subulate appressed bracts; the lower longer and some of them 3-parted: flowers terminating and also sparsely spicately disposed along the branchlets, 2 lines long.*—Wyoming (on the Upper Platte) and Idaho.

20. **G. tenerrima**, Gray. *Minutely and sparsely glandular, low, effusely much branched; branches filiform: leaves entire: flowers loosely panicked, on slender divergent pedicels, minute.*—Proc. Am. Acad. viii. 277. Bear River Valley, Utah.

++ ++ *Corolla larger (3 to 12 lines), funnelform, purplish or yellow: leaves once or twice pinnately divided: ovules few or numerous in the cells: viscid-glandular.*

21. **G. inconspicua**, Dougl. A span to a foot or more high, usually with slight woolly pubescence when young, and viscid-glandular, *branching from the base: leaves mostly pinnatifid or pinnately-parted, or the lowest bipinnatifid, with short mucronate-cuspidate lobes; the uppermost becoming small, subulate and entire: flowers either somewhat crowded and subsessile or at length loosely panicked and some of them slender-pedicelled: corolla violet or purplish (3 to 5 lines long), narrowly funnelform.*—From Wyoming to Texas and westward.

22. **G. Brandegei**, Gray. Very viscid with glandular pubescence, pleasantly odoriferous, caespitose: *stems a span to near a foot high, simple: leaves all pinnate, elongated-linear in outline, the radical crowded, the cauline scattered; leaflets very small and numerous, from oval to oblong-linear, some simple, others 2-parted and so appearing verticillate: flowers several in a short and racemiform leafy thyrus: corolla golden yellow, trumpet-shaped, an inch or less long.*—Proc. Am. Acad. xi. 85. On the face of cliffs in S. W. Colorado, Brandegee.

Var. **Lambornii**, Gray. *Corolla lurid-yellowish or greenish.*—Synopt. Fl. ii. 149. Alpine region of Sierra Blanca, S. Colorado.

3. POLEMONIUM, TOURN. GREEK VALERIAN. JACOB'S LADDER.

Inflorescence racemiform, thyriform, or cymulose-paniculate: flowers blue or white, rarely purplish, usually showy.

* *Corolla narrowly funnelform; its tube exceeding the calyx and longer than the limb: filaments naked or nearly so and not dilated at base: leaflets very small*

and crowded, so as seemingly to be verticillate: inflorescence capitate-congested or spiciform.

1. **P. confertum**, Gray. A span or more high, glandular-pubescent and viscid, musky fragrant: leaflets 1 to 3 lines long, mostly 2 to 3 divided; the divisions from round-oval to oblong-linear: flowers densely crowded, honey-scented: corolla deep blue, $\frac{1}{2}$ to 1 inch long: ovules about 3 in each cell. — Proc. Acad. Philad. 1863, 73. Alpine regions from Colorado to California and northward.

Var **mellitum**, Gray. Usually a taller form: inflorescence more lax and leafy, becoming spiciform or racemose: corolla pale or sometimes white, an inch long, more narrowly funnelform. — With the type in Wyoming, Colorado, and Utah.

* * Corolla campanulate-funnelform; its tube not exceeding the calyx and shorter than the ample limb: filaments usually dilated and pilose-appendaged at base: leaflets simple and entire, sometimes confluent: inflorescence open.

+ Low, about a span high from caespitose-branching and mostly thickened rootstocks: flowering stems only 1 to 3-leaved: leaflets seldom $\frac{1}{2}$ inch long.

2. **P. viscosum**, Nutt. Dwarf and with thick densely tufted rootstocks, viscid-puberulent: leaflets very numerous and crowded or even imbricated, ovate or roundish, at most $1\frac{1}{2}$ lines long: flowers in a rather close cymulose cluster: corolla blue or whitish, its lobes about the length of the included tube: filaments not appendaged at base. — High summits towards the sources of the Platte, Nuttall.

3. **P. humile**, Willd. More slender, and from somewhat creeping rootstocks, more or less viscid-pubescent: leaflets 15 to 21, from round-oval to oblong, 2 to 6 lines long: flowers rather few in the clusters: corolla blue or purplish, its ampler lobes much longer than the short included tube: filaments pilose at the dilated base: ovules 2 to 4 and seeds 1 or 2 in each cell.

Var. **pulchellum**, Gray. Viscid pubescence mostly minute, or the leaflets often nearly glabrous and naked: flowers smaller: the lobes of the corolla only 2 or 3 lines long, violet or lavender blue, in some forms nearly white. — Synopt. Fl. ii. 150. *P. pulchellum*, Bunge. Mountains of Colorado and the Sierra Nevada, northward to the Arctic coast.

+ + Taller, a foot or more high, from slender rootstocks or roots: leaves and leaflets larger.

4. **P. cæruleum**, L. Either glabrous or viscid-pubescent: stem mostly strict and virgate, 1 to 3 feet high, 5 to 10-leaved: leaflets from linear-lanceolate to oblong-ovate, 9 to 20 lines long: flowers numerous in a naked and narrow thyrusus or panicle: corolla blue, an inch or less in diameter: style and stamens usually protruding. — From the Colorado mountains to California, and far northward; very much less abundant in the N. Atlantic States.

5. **P. foliosissimum**, Gray. Very viscid-pubescent throughout and strong-scented: stem very leafy throughout: leaflets from lanceolate to ovate-lanceolate: flowers corymbose-cymose, smaller: corolla commonly white or cream-color, sometimes violet, twice the length of the calyx: style and stamens not protruding. — Synopt. Fl. ii. 151. *P. cæruleum*, var. *foliosissimum*, Gray. Mountains of New Mexico, Colorado, Wyoming, and westward.

ORDER 52. **HYDROPHYLLACEÆ.** (WATERLEAF FAMILY.)

Herbs, commonly hairy, with mostly alternate leaves, regular 5-merous and 5-androus flowers: the ovary entire and 1-celled with 2 parietal (4 to many-ovuled) placentæ, or rarely 2-celled: style 2-cleft or 2 separate styles: fruit a 2-valved, 4 to many-seeded pod. Flowers chiefly blue or white, in one-sided cymes or racemes.

* Style more or less 2-cleft: ovary 1-celled, and mostly hispid, at least at the apex.

← Ovary lined with the dilated and fleshy placentæ.

1. **Hydrophyllum.** Stamens and style mostly conspicuously exserted. Leaves alternate. Calyx with or without a small appendage at each sinus. Corolla campanulate; the tube within bearing a linear longitudinal appendage opposite each lobe, with infolded edges, forming a nectariferous groove. Filaments bearded at the middle.
2. **Ellisia.** Stamens shorter than the corolla. Lower and sometimes all the leaves opposite. Calyx destitute of appendages at the sinuses, usually much enlarged under the fruit. Corolla campanulate, the internal appendages minute or obsolete.
← ← Ovary with narrow parietal placentæ, in fruit projecting inward more or less.
3. **Phacelia.** Calyx naked at the sinuses, deeply 5-parted. Stamens equally inserted low down on the corolla. Inflorescence scorpioid. Leaves all, or all but the lowest, alternate.
- ** Styles 2, distinct to the base: ovary more or less completely 2-celled, and in ours nearly glabrous.
4. **Nama.** Corolla funnelform or somewhat salverform. Filaments and styles more or less included; the former commonly unequal and often unequally inserted. Ovules and seeds numerous, on transverse lamelliform placentæ, which approximate or cohere in the axis of the ovary, but separate in the loculicidal dehiscence. Low herbs, with (in ours) entire leaves.

1. **HYDROPHYLLUM**, Tourn. WATERLEAF.

Herbs with petioled ample and lobed or divided alternate leaves, and cymose clusters of violet-blue or white flowers. Our species have fleshy horizontal rootstocks, the calyx naked at the sinuses, leaves pinnatifid or pinnate, and the peduncle elongated, surpassing the petiole.

1. **H. occidentale**, Gray. *Pubescent, hirsute, or sparingly hispid, a foot or two high: leaves elongated-oblong in outline, pinnately parted or divided into 7 to 15 divisions; divisions oblong, 1 or 2 inches long, mostly incised or few-cleft, obtuse: cymes mostly dense or capitate: calyx deeply parted, its divisions lanceolate: corolla violet-purple, varying to white, $\frac{1}{2}$ inch long.*—Proc. Am. Acad. x. 314.

Var. **Fendleri**, Gray. *Pubescence mainly hirsute or hispid: divisions of the leaves inclined to ovate-lanceolate, acute or acuminate, incisely serrate: cyme rather open: corolla white or nearly so.*—Shady ravines, from New Mexico to Colorado.

2. **H. Virginicum**, L. *Stem (1 or 2 feet high) and bright green leaves almost glabrous, or with short scattered hairs: leaves ovate in general outline, 3 to 5-parted or divided; divisions (2 to 4 inches long) ovate-lanceolate or*

rhomboid-ovate, acuminate or acute, coarsely incised-toothed; the lowest commonly 2-cleft and the terminal one often 3-lobed: peduncle usually once or twice forked: cyme at length open: calyx 5-parted to the very base into narrow linear and spreading hispid-ciliate divisions: corolla nearly white or sometimes deep violet, about $\frac{1}{4}$ inch long. — Across the continent.

2. ELLISIA, L.

Plants with tender somewhat hirsute herbage: peduncles solitary or racemose: corolla whitish, mostly small in comparison with the stellate calyx. In ours the leaves are once pinnately parted, and the upper mostly alternate.

1. **E. Nyctelea**, L. A span to a foot high, at length very diffuse: leaves on naked or barely margined petioles; the divisions 7 to 13, lanceolate, acute, mostly 1 to 3-toothed or lobed: peduncles solitary in the forks or opposite the leaves, or some of the later ones racemose and secund: calyx-lobes acuminate, longer than the capsule: corolla rather shorter than the calyx. — Upper Arkansas, Colorado, to the Saskatchewan, and eastward across the continent.

3. PHACELIA, Juss.

Corolla blue, purple, or white, never yellow, except the tube of certain species; the tube with or without internal folds: calyx-lobes more or less enlarging in fruit: seed coat reticulated or pitted.

§ 1. *A pair of ovules to each placenta: seeds as many or by abortion fewer: lobes of the campanulate corolla entire (or rarely erose-dentate); the tube with 10 laminate appendages in pairs at the base of the stamens.* — EUPHACELIA.

* *Leaves all simple and entire, or some of the lower pinnately 3 to 5-parted or divided: capsule ovate, acute: seeds densely alveolate-punctate.*

1. **P. circinata**, Jacq. f. Hispid and the foliage strigose, and either green or canescent, a span to 2 feet high: leaves from lanceolate to ovate, acute; the lower tapering into a petiole and commonly some of them with one or two pairs of smaller lateral leaflets: inflorescence hispid; the dense spikes thyrsoïd-congested: corolla whitish or bluish: filaments much exserted, sparingly bearded. — On dry ground, from New Mexico and California to the Dakotas and British Columbia.

* * *Leaves pinnately toothed, lobed, or compound, and the lobes or divisions toothed or incised: capsule globular or ovoid, obtuse: seeds with excavated ventral face divided by a salient ridge.*

+ *Calyx, etc. not setose-hispid.*

2. **P. integrifolia**, Torr. A span to 2 feet high, strict, viscid-pubescent or hirsute, very leafy: leaves ovate-oblong or lanceolate, sessile or the lower short-petioled with a commonly subcordate base, simply or mostly doubly crenate-toothed, sometimes incised: spikes crowded, at first thyrsoïd: corolla whitish or bluish: stamens and style long exserted. — Ann. Lyc. N. Y. ii. 222. Dry soil, Colorado to Texas, Arizona, and Utah.

3. **P. glandulosa**, Nutt. Viscid-pubescent and glandular, softly if at all hirsute, a span to a foot or more high: *leaves irregularly and interruptedly twice pinnatifid, or below divided*; the numerous lobes small, somewhat incised, obtuse: corolla bluish, purplish, or white, with lobes shorter than the tube: stamens and style moderately or conspicuously exserted. — Gravelly soil, Colorado to Arizona and Texas.

Var. **Neo-Mexicana**, Gray. Lobes of the corolla either slightly or conspicuously erose-denticulate. — *P. Neo-Mexicana*, Thurber.

+ + *Calyx more or less setose-hispid.*

4 **P. Popei**, Torr. & Gray. Viscid-pubescent and hispid with spreading hairs, a span to a foot high: leaves bipinnately parted or pinnatifid; the divisions pinnatifid, with 5 to 9 short, obtuse lobes: calyx-lobes a little longer than the globose capsule: corolla white, campanulate, its lobes entire: stamens at length much exserted. — Pacif. R. Rep. ii. 172. Colorado and southward. Included under *P. glandulosa*, Nutt., in Synopt. Fl. ii. 160, but restored in Proc. Am. Acad. xix. 87.

§ 2. *Ovules and seeds several (6 to 12) or more numerous on each placenta: appendages of the mostly campanulate corolla in the form of 10 vertical salient lamellæ.* — EUTOCA.

5. **P. sericea**, Gray. A span to a foot high from a branching caudex, silky-pubescent or canescent, or the simple virgate stems and inflorescence villous-hirsute, rather leafy to the top: *leaves pinnately parted into linear or narrow-oblong numerous and often again few-cleft or pinnatifid divisions*, silky-canescant or sometimes greenish; the lower petioled; the uppermost simpler and nearly sessile: *short spikes crowded in a naked spike-like thyrsus*: corolla violet-blue or whitish: *stamens long exserted: capsule a little longer than the calyx.* — Mountains of Colorado, Nevada, and northward.

6. **P. Menziesii**, Torr. A span to a foot high, at length paniculate-branched, hispid or roughish-hirsute: *leaves mostly sessile, linear or lanceolate and entire, or some of them deeply cleft*; the lobes few or single, linear or lanceolate, entire: *spikes or spike-like racemes thyrsoid-paniculate*, at length elongated and erect: corolla bright violet or sometimes white: *stamens about the length of the corolla: capsule shorter than the calyx.* — Watson, Bot. King Exp. 252. Montana to Utah and westward.

4. NAMA, L.

Low herbs: the corolla purple, bluish, or white. In ours the corolla is short-funnelform and hardly exceeding the calyx, the flowers are in the forks of the stem, and the leaves are entire.

1. **N. dichotomum**, Ruiz & Pav., var. **angustifolium**, Gray. Erect, a span high, minutely pubescent, glandular: stem repeatedly forked and with a nearly sessile flower in each fork: leaves narrow, linear or nearly so: sepals narrowly linear: seeds marked with about 5 longitudinal rows of large pits, from 4 to 6 in each row. — Proc. Am. Acad. viii. 284. Colorado and New Mexico.

ORDER 53. **BORRAGINACEÆ.** (BORAGE FAMILY.)

Chiefly rough-hairy herbs, with alternate entire leaves, and symmetrical flowers with a 5-parted calyx, a regular 5-lobed corolla, 5 stamens inserted on its tube, a single style and a deeply 4-lobed ovary (occasionally undivided), which forms in fruit 4 seed-like nutlets, each with a single seed. — Flowers mostly on one side of the branches of a reduced cyme, imitating a scorpioid spike or raceme.

A. Ovary undivided (or only laterally 4-lobed) and surmounted by the style.

1. **Coldenia.** Calyx 5-parted; the divisions narrow. Corolla short-funnelform or nearly salverform; the lobes rounded, imbricated or sometimes partly convolute in the bud. Style 2-cleft or 2-parted; ovary (in ours) laterally 4-lobed. Fruit separating at maturity into 4 one-seeded nutlets, or by abortion fewer.
2. **Heliotropium.** Calyx deeply 5-parted, persistent. Corolla salverform or funnelform, plaited and mostly imbricated in the bud. Anthers connivent, sometimes cohering by pointed tips. Style entire or none; stigma peltate-annular, forming a complete ring, surmounted usually by an entire or 2-lobed tip or appendage; ovary 4-celled. Fruit 2 or 4-lobed, separating into two 2-celled and 2-seeded carpels or more commonly into 4 one-seeded nutlets.

B. Ovary 4-parted from above into 1-celled 1-ovuled divisions surrounding the base of the undivided style; stigma terminal, not annular.

* Nutlets obliquely attached by more or less of the ventral face or angle, or by the base or prolongation of it, to

+ The more or less elevated gynobase which supports the style, not stipitate.

3. **Echinosperrum.** Nutlets armed (either along a distinct margin or more or less over the whole back) with glochidiate prickles, forming burs. Calyx reflexed or open in fruit. Corolla white or blue; the throat closed with prominent fornicate appendages.
4. **Omphalodes.** Nutlets ascending or subhorizontal, with depressed back surrounded by a wing or margin which at maturity is reflexed, and its pectinate or spinulose teeth when present not glochidiate (disk sometimes so) somewhat supra-basal or ventral in attachment. Corolla rotate or very short funnelform, bright blue.
5. **Krynitzkia.** Nutlets erect, convex on the back and naked, wholly unappendaged (rarely with a narrow plane border), attached by the inner side above the middle or more or less towards the base. Corolla rotate or funnelform, white, and mostly small.

+ + Nutlets sessile or obscurely stipitate on a flat or merely convex receptacle.

6. **Mertensia.** Corolla from tubular-funnelform or trumpet-shaped to almost campanulate, with open throat, bearing obvious or obsolete transverse folds for crests. Stigma entire. Nutlets attached by a small or short scar just above the base to a barely or sometimes strongly convex gynobase. Often smooth and glabrous, with blue or rarely white flowers, mostly bractless.

** Nutlets sessile and directly (usually centrally) attached by the very base to a plane gynobase.

7. **Myosotis.** Corolla short-salverform or almost rotate; its throat contracted by transverse crests; the rounded lobes convolute in the bud. Nutlets small, smooth and shining, thin-crustaceous. Racemes mainly ebracteate.
8. **Lithospermum.** Corolla salverform, funnelform, or sometimes approaching campanulate, either naked or with pubescent lines or intruded gibbosities or low transverse crests at the throat. Nutlets ovoid, bony, either polished and white or dull and rough. Flowers all subtended by leaves or bracts.

9. **Onosmodium**. Corolla tubular or oblong-funnelform, with open and wholly unappendaged throat; the lobes erect or hardly spreading; the sinuses more or less inflexed. Style filiform or capillary, very long; stigma exerted before the corolla opens. Nutlets ovoid or globular, bony, smooth and polished, white. Flowers all subtended by leafy bracts.

1. COLDENIA, L.

Low herbaceous plants, canescent or hispid: with small and mostly white flowers sessile and usually in clusters: leaves entire, petioled, veined.

1. **C. Nuttallii**, Hook. Prostrate annual, repeatedly and divergently dichotomous: leaves ovate or rhomboid-rotund, 2 to 4 lines long and on longer petioles, with 2 or 3 pairs of strong and somewhat curving veins, and margins somewhat revolute: flowers densely clustered in the forks and at the ends of the naked branches: filaments inserted nearly in the throat of the pink or whitish corolla, the tube of which bears 5 short obtuse scales near the base: nutlets marked with a linear and raphae-like ventral scar. — Dry plains, from Wyoming to Washington and southward to Arizona and California.

2. HELIOTROPIMUM, TOURN. HELIOTROPE.

Low herbs or undershrubs: the flowers almost always small. In ours the corolla is large, white, and not appendaged

* *Fruit didymous, solid: anthers slightly cohering by their minutely bearded tips: style long and filiform; cone of the stigma truncate and bearded with a pencilate tuft of strong bristles: flowers scattered*

1. **H. convolvulaceum**, Gray. Low spreading annual, strigose-hirsute and hoary, much branched: leaves lanceolate or sometimes nearly ovate and sometimes linear, short-petioled: flowers generally opposite the leaves and terminal, short-peduncled: limb of the corolla ample, angulate-lobed; the tube strigose-hirsute, about twice the length of the sepals. — Sandy plains, Nebraska to W. Texas and westward.

* * *Fruit 4-lobed: anthers free: style none; stigma umbrella-shaped, not surmounted by a cone: flowers in distinct unilateral scorpioid spikes*

2. **H. Curassavicum**, L. Wholly glabrous and glaucous, diffusely spreading, a span to a foot high: leaves succulent, oblanceolate, varying from nearly linear to obovate: spikes mostly in pairs or twice forked, densely flowered: corolla white, with a yellow eye: stigma as wide as the glabrous ovary, flat. — Along the sea-coasts, also in the interior in saline soils.

3. ECHINOSPERMUM, LEHM. STICKSEED.

Either pubescent or hispid: with racemose or spicate flowers, usually small, bluish or whitish. The nutlets are troublesome burs.

* *Racemes panicle, leafy-bracteate only at base, minutely bracteate or bractless above: pedicels recurved or deflexed in fruit: calyx-lobes shorter than the fruit, and at length reflexed under it: scar of the nutlets ovate or triangular: plants pubescent or hirsute, but not hispid. In ours the corolla is rotate.*

1. **E. floribundum**, Lehm. Rather strict, 2 feet or more high, or sometimes smaller: leaves from oblong to linear-lanceolate; the lowest tapering into

marginated petioles: racemes numerous, commonly geminate and in fruit rather strict: nutlets with elongated triangular back naked, merely scabrous; and the margin armed with a close row of flat subulate prickles, their bases often confluent. — *E. deflexum*, var. *floribundum*, Watson. From New Mexico and California northward to British America.

2. *E. ciliatum*, Gray. A foot or more high, *canescently hirsute, the hairs on the lower part of the stem retrorse: leaves tomentose-hirsute, ciliate, sessile, linear; the lower 4 inches long and 2 lines wide; the upper an inch long: racemes subcorymbose: fruit unknown.* — Proc. Am. Acad. xvii. 225. *Cynoglossum ciliatum*, Dougl. Tributaries of the Columbia and eastward to the Rocky Mountains, Douglas.

* * *Spikes leafy-bracteate: pedicels erect or merely spreading: calyx-lobes mostly exceeding the fruit, becoming foliaceous and often unequal: scar of the nutlets long and narrow: plants with rough or hispid pubescence: leaves linear, lanceolate, or the lower somewhat spatulate.*

3. *E. Redowskii*, Lehm. Erect, a span to 2 feet high, paniculately branched: nutlets irregularly and minutely muricately tuberculate; the margin armed with a single row of stout flattened prickles, which are not rarely confluent at base.

Var. *occidentale*, Watson. Less strict, at length diffuse, and the tubercles of the nutlets sharp instead of blunt or roundish. — Bot. King Exp. 246. From Arizona and Texas northward.

Var. *cupulatum*, Gray. Prickles of the nutlet broadened and thickened below and united into a wing or border, which often indurates and enlarges, forming a cup, with margin more or less incurved at maturity, sometimes only the tips of the prickles free. — Bot. Calif. i. 530. From Nevada to Texas and Nebraska. With the preceding form.

4. OMPHALODES, Tourn.

Ours are dwarf caespitose alpine or mountain perennials with bright blue flowers, forming the section *Eritrichium*. — Gray, Proc. Am. Acad. xx. 263.

1. *O. nana*, Gray, var. *aretioides*, Gray. Densely caespitose in pulvinate tufts, rising an inch or two above the surface, *densely villous with long soft white hairs* which are sometimes papillose-dilated at base: *leaves varying from ovate to lanceolate: flowers terminating very short densely leafy shoots, or more racemose on developed few-leaved stems: nutlets with a pectinate-toothed or spinulose dorsal border.* — Loc. cit. *Eritrichium nanum*, Schrad., var. *aretioides*, Herder. *E. villosum*, var. *aretioides*, Gray. Highest alpine, Colorado, Utah, Wyoming, and northward.

2. *O. Howardi*, Gray. Densely caespitose, *sericeous-canescant with appressed pubescence: leaves spatulate-linear, 5 to 8 lines long, mostly crowded on the tufted branches of the caudex; the flowering stems 3 to 4-leaved: cyme either dichotomous or simple racemiform, few-flowered: nutlets shining, naked, with angulate-margined dorsal border.* — Loc. cit. *Echinosperrum ciliatum*, Gray, var. *Howardi*, Gray. *Cynoglossum Howardi*, Gray. Mountains of Montana and westward to the Cascades, Howard, Canby, Tweedy.

5. **KRYNITZKIA**, Fisch. & Meyer.

Annual herbs or some perennials, with white and mostly small flowers. Includes *Eritrichium* § *Krynitzkia*, and § *Eueritrichium* *Myosotidea*, Gray, Synopt. Fl. ii. 191. — Gray, Proc. Amer. Acad. xx. 264.

§ 1. *Nutlets more or less ovate, rugose, sometimes keeled dorsally or ventrally, attached at the base by a very small areola either to a depressed or little elevated gynobase: low and mostly diffuse or spreading annuals, sparsely or minutely hirsute: leaves linear: flowers very small (a line long).—MYOSOTIDEA.*

1. **K. Californica**, Gray. Slender, more or less hirsute: stems flowering from near the base: flowers almost sessile, most or all the lower accompanied by leaves or bracts, at length scattered: nutlets transversely rugose and minutely scabrous or smooth; the scar almost basal. — Loc. cit. 266. *Eritrichium Californicum*, DC. Spring or muddy ground, from Wyoming and New Mexico to California and Oregon.

Var. **subglochidiata**, Gray. Slightly succulent: lower leaves inclined to spatulate: nutlets when young minutely more or less hirsute or hispid, especially on the crests of the rugosities, some of these little bristles becoming stouter and appearing glochidiate under a lens. — Bot. Calif. i. 526. Wyoming and Colorado to California.

§ 2. *Nutlets never rugose, angulate or sulcate ventrally, with convex back neither keeled nor angulate, attached from next the base to the middle or even to the apex to the elevated gynobase: corolla small, its short tube not exceeding the calyx; throat either naked or with appendages not exerted: annuals, with flowers scorpioid-spicate.—EUKRYNITZKIA.*

* *Calyx early circumscissile, the 5 left upper portion falling away, leaving a membranaceous base persistent around the fruit: nutlets ovate-acuminate, smooth or minutely punctilulate-scabrous, attached by a narrow groove (with transverse basal bifurcation) for nearly the whole length to the subulate gynobase: corolla with naked and open throat.*

2. **K. circumscissa**, Gray. Depressed-spreading, very much branched, an inch to a span high, whitish-hispid throughout: narrow linear leaves ($\frac{1}{4}$ to $\frac{1}{2}$ inch long) and very small flowers crowded, especially on the upper part of the branches. — Loc. cit. 275. *Eritrichium circumscissum*, Gray. Dry plains, Wyoming and Utah to California and Washington.

* * *Calyx not circumscissile, 5-parted, conspicuously and often pungently hispid: the whole calyx (or short pedicel) often inclined to disarticulate at maturity, forming a sort of bur loosely enclosing the nutlets.*

+ *Sepals never very narrow, with a strong rigid rib: nutlets mostly dull: diffusely branching rough-hispid herbs.*

3. **K. crassisejala**, Gray. A span high, very rough-hispid: leaves oblanceolate and linear-spatulate: persistent calyx very hispid with yellowish or fulvous bristles; its lobes greatly thickened below in fruit: nutlets ovate, acute, dissimilar, 3 of them muciculate-granulate and one larger and smooth or nearly so, fixed to the conical-pyramidal gynobase from base to middle. — Loc. cit. 268. *Eritrichium crassisejalum*, Torr. & Gray. From New Mexico and W. Texas to Nebraska and the Saskatchewan.

4. **K. Pattersoni**, Gray. About a foot high, rough-hispid: leaves narrowly spatulate or linear: calyx hispid with pungent bristles; its lobes linear-lanceolate, less thickened: nutlet (usually only one maturing) ovate-acuminate, smooth, attached from base to middle to the subulate-pyramidal gynobase. — Loc. cit. 268. At the base of the Rocky Mountains in Colorado, *Patterson*, *Hooker & Gray*.

5. **K. Fendleri**, Gray. Erect, hardly a foot high, paniculately branched, rather rigid: as in the last, but leaves linear, sepals narrowly linear, nutlets more attenuate upwards and attached almost to the apex to the narrowly subulate gynobase. — Loc. cit. 268. Heretofore confounded with *K. (Eritrichium) leiocarpa*. From the Saskatchewan to Colorado and New Mexico.

+ + Sepals narrow, neither thickened nor with prominent rib: nutlets very smooth, shining: erect slender herbs, somewhat hispid.

6. **K. Watsoni**, Gray. A foot high: sepals of fruiting calyx scarcely 2 lines long, lanceolate, sparsely setose-hispid: nutlets (a line long) narrow, subtriquetrous, about oblong-lanceolate in outline, attached almost the whole length to the filiform-subulate gynobase. — Loc. cit. 271. Wasatch Mountains, Utah, *Watson*. A part of *Eritrichium leiocarpum*, Bot. King Exped.

§ 3. Nutlets triquetrous or three-angled, with acute lateral angles, attached to a mostly subulate gynobase: generally biennial or perennial herbs: corolla with throat appendages prominent or exerted. — PSEUDOKRYNITZKIA. Ours are stout, with rather broad leaves, and flowers thyrsoid-congested.

* Fruit depressed-globose.

7. **K. Jamesii**, Gray. A span or two high, branched from the hard or woody base, canescently silky-tomentose and somewhat hirsute, becoming even hispid in age: leaves oblanceolate or the upper linear: spikes somewhat panicked or thyrsoid-crowded: fruiting calyx mostly closing over the fruit, which consists of four very smooth and shining broadly triangular ($\frac{1}{3}$ globe) nutlets. — Loc. cit. 278. *Eritrichium Jamesii*, Torr. From Texas to S. California and northward to Wyoming.

* * Fruit more or less pyramidal.

+ Tube of the corolla not longer than the calyx and little if any longer than the lobes: a ring of 10 small scales or glands above the base within.

8. **K. virgata**, Gray. Very hispid, not at all canescent: stem strict, a foot or two high, flowering for most of its length in short and dense nearly sessile clusters, which are generally much shorter than the elongated linear subtending leaves, and forming a long virgate leafy spike: nutlets broad ovate, sparingly papillose on the back. — Loc. cit. 279. *Eritrichium glomeratum*, var. *virgatum*, Porter. Eastern slopes of the Rocky Mountains in Colorado.

9. **K. glomerata**, Gray. Grayish-hirsute and hispid, a foot or more high: leaves spatulate or linear-spatulate: inflorescence thyrsiform and mostly dense: calyx very setose-hispid: nutlets ovate, more or less tuberculate-rugose on the back. — Loc. cit. 279. *Eritrichium glomeratum*, DC. From Arizona and New Mexico to the Saskatchewan and Washington.

10. **K. sericea**, Gray. Barely a span high, pubescence less hispid and generally canescent, at least the lower leaves, these spatulate: thyrsus spiciform: pubescence and bristles of the calyx either whitish or tawny yellow: nutlets

oblong-ovate, somewhat rugose-tuberculate on the back. — Loc. cit. 279. — *Eritrichium glomeratum*, var. *humile*, Gray. Alpine and subalpine, from Colorado and Utah to Montana and Oregon.

+ + *Tube of the salverform corolla longer than the calyx and 2 or 3 times the length of the lobes: the ring inconspicuous, its glands indistinct: silky-canescenscent, and with contracted thyrsoid inflorescence.*

11. **K. fulvocanescens**, Gray. A span or so high, cespitose: leaves linear-spatulate or oblanceolate, silky-strigose or even tomentose; the lower with bright white and soft hairs; the upper and the thyrsoid glomerate inflorescence and calyx with fulvous-yellow more hirsute hairs and some hispid bristles: nutlets ovate, more or less papillose or tuberculate rugose on the back. — Loc. cit. 280. *Eritrichium fulvocanescens*, Gray. Mountains of Texas and New Mexico to those of Nevada and Wyoming.

6. MERTENSIA, Roth. LUNGWORT.

Either glabrous or with some pubescence: the leaves usually broad, and the lowermost petioled: the flowers usually showy, blue, purple, or rarely white, paniculate-racemose or cymose. — In our species the corolla has a conspicuously 5-lobed limb, with small crests in the throat.

* *Filaments enlarged, as broad as the anthers, always inserted in the throat of the corolla: style long and capillary, generally somewhat exerted.*

+ *Tube of the corolla twice or thrice the length of the limb and of the calyx.*

1. **M. oblongifolia**, Don. A span or so high, smooth or nearly so: leaves mostly oblong or spatulate-lanceolate, rather succulent: flowers in a somewhat close cluster: lobes of the calyx lanceolate or linear, mostly acute. — From British Columbia southward, through the mountains of Montana to Utah and Arizona.

+ + *Tube of the corolla little or not twice longer than the throat and limb.*

2. **M. Sibirica**, Don. Stems tall, 1 to 5 feet high: pale and glaucescent, glabrous and smooth or nearly so, very leafy: leaves ample, veiny; cauline leaves oblong- or lanceolate-ovate, hirsute-ciliate; the upper with very acute or a um'inate apex; the lowest ovate or subcordate (3 or 4 inches long): short racemes panicled: calyx-lobes oblong or oblong-linear, obtuse, commonly ciliate, $\frac{1}{2}$ or $\frac{1}{3}$ the length of the tube of the bright light-blue corolla. — From the mountains of Colorado westward to the Sierra Nevada, and far northward.

3. **M. paniculata**, Don. Greener, roughish and more or less pubescent: size and leaves about as in the last: racemes loosely panicled: calyx-lobes lanceolate or linear and mostly acute, hispid-ciliate or hirsute, equaling or only $\frac{1}{2}$ shorter than the tube of the purple-blue corolla. — From Nevada and Utah to Hudson Bay and northward.

4. **M. lanceolata**, DC. Either glabrous or hirsute-pubescent, simple or paniculately branched: stems a span to a foot high: leaves pale or glaucescent, from spatulate-oblong to lanceolate-linear, 1 or 2 inches long, obtuse or barely acute: racemes at length loosely panicled: calyx-lobes lanceolate, acute or obtuse, ciliate or hirsute or glabrous, more or less shorter than the tube of the blue

corolla, which is hairy near the base within. — From the Dakotas and Wyoming to New Mexico.

Var. **Fendleri**, Gray. A commonly hirsute form, with calyx 5-cleft only to the middle. — Proc. Am. Acad. x. 52.

* * *Filaments narrower than the anthers, inserted either on the margin of the throat or about the middle of the tube: style included.*

5. **M. alpina**, Don. A span or more high, either nearly glabrous or pubescent: leaves oblong, somewhat spatulate or lanceolate, rather obtuse; the cauline sessile (1 or 2 inches long): flowers in a close or at length loose cluster: calyx-lobes equalling or rather shorter than the tube of the corolla: anthers nearly sessile. — High elevations in mountains of Colorado and Utah.

7. MYOSOTIS, L. FORGET-ME-NOT.

Low and spreading pubescent herbs, with sessile stem leaves and small blue flowers in bractless racemes. In ours the calyx is beset with hairs, some of them bristly and having minutely hooked tips.

1. **M. sylvatica**, Hoffm. Hirsute-pubescent, either green or cinereous: leaves oblong-linear or lanceolate; the radical conspicuously petioled: pedicels as long as the calyx or longer: calyx-lobes erect or slightly closing in fruit: nutlets more or less margined and carinate ventrally at the apex.

Var. **alpestris**, Koch. Stems tufted, 3 to 9 inches high: racemes more dense: pedicels shorter and thicker, seldom longer than the calyx. — In high alpine regions in the mountains of Colorado and Wyoming, and northward.

8. LITHOSPERMUM, Tourn. GROMWELL.

Herbs with reddish roots, sessile leaves, and axillary or subaxillary or leafy-bracted flowers: stamens with very short filaments, and nutlets (in ours) white, smooth and polished.

* *Flowers rather small: corolla greenish-yellow, short; its tube hardly if at all longer than the calyx, nearly naked at the throat.*

1. **L. pilosum**, Nutt. Soft-hirsute and pubescent, pale or canescent: stems numerous from a stout root, a foot high, mostly simple, very leafy: leaves linear and linear-lanceolate, mostly tapering from near the base to apex: flowers densely crowded in a leafy thyrus: corolla campanulate-funnel-form, almost $\frac{1}{2}$ inch long, silky outside. — From British Columbia and Montana to Utah and California.

* * *Flowers mostly showy: corolla yellow, much exceeding the calyx; pubescent crests in the throat apparent. Plants with long and deep red roots (Puccoon).*

← *Corolla light yellow: later floral leaves reduced to bracts, not surpassing the calyx.*

2. **L. multiflorum**, Torr. Minutely strigose-hispid: stems virgate, a foot or two high: leaves linear or linear-lanceolate: flowers numerous, short-pedicelled, the latter spicate: corolla narrow (5 or 6 lines long), with very short rounded lobes and tube fully twice the length of the calyx; the crests or folds in the throat inconspicuous. — In the mountains from Colorado to Arizona and Texas.

+ + Corolla bright and deep yellow or orange; the tube from $\frac{1}{2}$ to twice longer than the calyx, and the crests at the throat little if at all projecting or arching: floral leaves or foliaceous bracts large, much surpassing the calyx.

3. **L. canescens**, Lehm. More or less canescent when young: stem hirsute, a span to a foot or more high: leaves oblong-linear or the upper varying to ovate-oblong, mostly obtuse, softly silky-pubescent, greener with age but not rough: corolla orange-yellow, and glandular ring at the base naked: flowers nearly sessile. — From Arizona and New Mexico to the Saskatchewan, Upper Canada, and Alabama. "Puccoon" of the Indians.

4. **L. hirtum**, Lehm. Hispid or hirsute and at length rough, a foot or two high: leaves lanceolate or the lower linear and floral ovate-oblong: corolla bright orange; the ring at the base within bearing 10 very hirsute lobes or teeth: flowers mostly pedicelled. — From Colorado to Minnesota and Florida.

+ + + Corolla bright yellow, salverform; its tube in well-developed flowers 2 to 4 times the length of the calyx; the crests in the throat conspicuous and arching.

5. **L. angustifolium**, Michx. Erect or diffusely branched from the base, a span to a foot or more high, minutely scabrous-strigose and somewhat cinereous: leaves all linear: flowers pedicelled, leafy-bracted, of two sorts; the earlier and conspicuous kind with corolla tube an inch or less in length; the later ones, and those of diffusely branching plants, with inconspicuous or small and pale corolla, without crests in the throat, probably cleistogenous. — From Utah and Arizona to Texas, Wisconsin, and the Saskatchewan.

9. ONOSMODIUM, Michx.

Rather stout and coarse, rough-hispid or hirsute, with leafy-bracteate flowers crowded in scorpioid spikes or racemes; the bracts resembling leaves: corolla greenish-white or yellowish-green; a glandular 10-lobed ring adnate to the base of the tube within. In ours the corolla is seldom twice the length of the calyx, and the leaves are pinnately nervose-ribbed.

1. **O. Carolinianum**, DC. Stout, 2 or 3 feet high, shaggy-hispid: leaves ovate-lanceolate and oblong-lanceolate, acute, 5 to 9-ribbed, generally hairy both sides: flowers nearly sessile: corolla lobes very hairy outside. — Colorado and eastward.

Var. **molle**, Gray. A foot or two high: the pubescence shorter and less spreading or appressed: leaves mostly smaller (2 inches long), when young softly strigose-canescient beneath. — Synopt. Fl. ii. 206. *O. molle*, Michx. From Utah to Texas, Illinois, and the Saskatchewan.

ORDER 54. CONVULVULACEÆ. (CONVOLVULUS FAMILY.)

Chiefly twining or trailing herbs, with alternate leaves (or scales) and regular 5-androus flowers; a calyx of 5 imbricated sepals; a 5-plaited or 5-lobed corolla convolute or twisted in the bud; a 2-celled ovary, with a pair of ovules in each cell, the cells sometimes doubled by a false partition. In ours the ovary is entire.

Tribe I. Plants with ordinary foliage, not parasitic.

1. **Ipomœa.** Style undivided, terminated by a single capitate or globose stigma. Corolla from salverform or funnelform to nearly campanulate.
2. **Convolvulus.** Style undivided or 2-cleft only at the apex: stigmas 2, from linear-filiform to subulate or ovate. Corolla from funnelform to campanulate.
3. **Evolvulus.** Styles 2, distinct or sometimes united below, each 2-cleft: stigmas linear-filiform or somewhat clavate. Corolla from funnelform to almost rotate.

Tribe II. Leaflets parasitic twining herbs, destitute of foliage and of all green color.

4. **Cuscuta.** Corolla imbricated in the bud, appendaged below the stamens.

1. IPOMŒA, L. MORNING-GLORY.

Calyx not bracteate at base, but the outer sepals commonly larger: limb of corolla entire, or barely angulate or lobed.

1. **I. leptophylla**, Torr. Very glabrous: stems erect or ascending (2 to 4 feet high) from an immense root, with recurving slender branches: leaves linear (2 to 4 inches long), short-petioled, acute: peduncle short, 1 or 2-flowered: outer sepals shorter: corolla pink-purple, funnelform, about 3 inches long: seeds rusty-pubescent. — Frem. Rep. 95. Plains of Nebraska and Wyoming to Texas and New Mexico.

2. CONVOLVULUS, L. BINDWEED.

Twining or prostrate, with small or large flowers. Includes *Calystegia*.

* *Stigmas from ovate or oval to oblong, very flat: solitary flower involucellate by a pair of persistent broad bracts, which are close to the calyx and enclose or exceed it.*

1. **C. sepium**, L. Glabrous or pubescent, freely twining: leaves slender-petioled, deltoid-hastate and triangular sagittate (2 to 5 inches long), acute or acuminate; the basal lobes or auricles either entire or angulate 2 to 3-lobed: peduncles mostly elongated: bracts cordate-ovate or somewhat sagittate, commonly acute: corolla broadly funnelform, 2 inches long, white or tinged with rose-color. — *Calystegia sepium*, R. Br. From Utah to Canada and the N. Atlantic States.

Var. **Americanus**, Sims. Corolla pink or rose-purple: bracts obtuse. — From Oregon to Canada and the Carolinas.

Var. **repens**, Gray. Corolla from almost white to rose color: bracts from very obtuse to acute: herbage from minutely to tomentose-pubescent: sterile and sometimes flowering stems extensively prostrate: leaves more narrowly sagittate or cordate, the basal lobes commonly obtuse or rounded and entire — Synopt. Fl. ii. 215. *Calystegia sepium*, var. *pubescens*, Gray. From New Mexico to Texas, the Dakotas, and eastward.

* * *Stigmas filiform or narrowly linear: no bracts at or near the base of the calyx.*

2. **C. incanus**, Vahl. Cinereous or canescent with a close and short silky pubescence: stems filiform, 1 to 3 feet long, mainly procumbent: leaves polymorphous; some simply lanceolate- or linear-sagittate or hastate, obtuse and mucronate, entire, and with the narrow elongated basal lobes entire or 2

to 3-toothed; some pedate, having narrowly 2 to 3-cleft lateral lobes or divisions; some more coarsely 3 to 5-parted, with lobes entire or coarsely sinuate-dentate: peduncles 1 to 2-flowered, as long as the leaf: corolla white or tinged with rose, $\frac{1}{2}$ inch long, the angles salient-acuminate. — Includes *C. lobatus*, Eng. & Gray. S. Colorado and Arkansas to Texas and Arizona.

3. EVOLVULUS, L.

Low and small rather suffrutescent plants, with erect or diffuse or prostrate (never twining) stems, entire leaves, one to few flowered peduncles, and small purple or blue almost rotate corolla. Our species has both sides of the leaves, stems, and calyx densely silky-villous.

1. **E. argenteus**, Pursh. Stems numerous from a lignescent base, rather stout and rigid, erect or ascending, a span or so high, very leafy: dense pubescence sometimes silvery-canescens, usually fulvous or ferruginous: leaves from spatulate and obtuse to linear-lanceolate and acute: pedicels very short. — Plains and prairies, from Nebraska to Wyoming, Colorado, and southward.

4. CUSCUTA, Tourn. DODDER.

Flowers 5- (rarely 4-) merous: calyx cleft or parted: corolla globular-urn-shaped, bell-shaped, or somewhat tubular: stamens inserted in the throat of the corolla above as many scale-like lacerate appendages: ovary globular, 2-celled, 4-ovuled: styles (in ours) distinct and terminated by peltate-capitate stigmas: embryo thread-shaped, spirally coiled, destitute of cotyledons — Leafless thread-like stems yellowish or reddish in color, bearing a few minute scales instead of leaves: flowers small, cymose-clustered, mostly white.

* *Capsule indehiscent.*

+ *Calyx gamosepalous.*

++ *Ovary and capsule depressed-globose: flowers in dense or globular clusters: corolla with a short and wide tube, in age remaining at the base of the capsule: styles mostly shorter than the ovary.*

1. **C. arvensis**, Beyrich. Stems pale and slender, low: flowers scarcely a line long: calyx-lobes obtuse, mostly very broad: those of the corolla acuminate, longer than the tube, with inflexed points: scales large, deeply fringed. — In rather dry soil, on various low plants, across the continent. The var. *pentagona*, found in Colorado, has a large and angled calyx.

++ ++ *Ovary and capsule pointed: the latter enveloped or capped by the marcescent corolla: flowers in paniculate cymes.*

= *Acute tips of corolla-lobes inflexed or corniculate.*

2. **C. decora**, Choisy. Stems coarse: flowers fleshy and more or less papillose: lobes of the calyx triangular, acute: those of the broadly campanulate corolla ovate-lanceolate, minutely crenulate, spreading: scales large, deeply fringed: capsule enveloped by the remains of the corolla.

Var. **pulcherrima**, Engelm. A larger form, with coarse stems, and conspicuous flowers $1\frac{1}{2}$ to $2\frac{1}{2}$ lines long and wide: anthers and stigmas yellow or deep purple. — On herbs and low shrubs in wet prairies, principally *Legumi*

nosæ and *Compositæ*. Across the continent, principally through its southern borders.

3. **C. inflexa**, Engelm. Like the last: flowers of the same structure, but *only a line long*, generally 4-merous; corolla deeper, *with erect lobes, finally capping the capsule: scales reduced to a few teeth*.—Open woods and dry prairies, on shrubs (hazels, etc.) or coarse herbs, from Arkansas to the Dakotas and eastward.

= = *Obtuse lobes of the corolla spreading.*

4. **C. Gronovii**, Willd. Stems coarse, often climbing high: corolla-lobes mostly shorter than the deeply campanulate tube: scales copiously fringed: capsule globose, umbonate.—In wet shady places from the Rocky Mountains eastward, most abundant in the Atlantic States, and everywhere very variable.

+ + *Calyx of 5 distinct and largely overlapping sepals, surrounded by 2 to 5 or more similar bracts: scales of corolla large and deeply fringed: capsule mostly one-seeded, capped by the marcescent corolla: flowers on bracteolate pedicels, in loose panicles.*

5. **C. cuspidata**, Engelm. Stems slender: flowers $1\frac{1}{2}$ to $2\frac{1}{2}$ lines long, thin, membranaceous when dry: bracts and sepals ovate-orbicular: oblong lobes of the corolla cuspidate or mucronate, rarely obtuse, shorter than the cylindrical tube: styles many times longer than the ovary, at length exserted.—Prairies, on *Ambrosia*, *Ira*, *Leguminosæ*, etc., from Colorado to Texas and Nebraska.

* * *Capsule more or less regularly circumscissile, usually capped by the remains of the corolla: styles capillary and lobes of the corolla acute.*

6. **C. umbellata**, HBK. Stems low and capillary: flowers $1\frac{1}{2}$ to 2 lines long, few together in umbel-like clusters, usually shorter than their pedicels: acute calyx-lobes and lanceolate-subulate lobes of the corolla longer than its shallow tube: scales deeply fringed and exceeding the tube.—Dry places, on low herbs (*Portulaca*, etc.), from S. E. Colorado to Texas and Arizona.

ORDER 55. SOLANACEÆ. (NIGHTSHADE FAMILY.)

Herbs, with alternate leaves, regular 5-merous and 5-androus flowers, in bractless pedicels; the corolla variously arranged in the bud, and mostly plaited. Stamens mostly equal and all perfect, inserted on the corolla. Style and stigma single.

* Fruit a berry.

+ Anthers longer than their filaments, either connivent or connate into a cone or cylinder: corolla rotate: calyx mostly unchanged in fruit.

1. **Solanum**. Anther-cells opening at the apex by a pore or short slit, and sometimes also longitudinally dehiscent.

+ + Anthers unconnected, mostly shorter than their filaments, destitute of terminal pores, dehiscent longitudinally.

2. **Chamæsaracha**. Calyx herbaceous and closely investing the fruit or most of it, not angled. Corolla rotate, 5-angulate. Berry globose, its summit usually more or less naked. Pedicels solitary in the axils, refracted or recurved in fruit.

3. **Physalis.** Calyx becoming much enlarged and membranaceous-inflated, completely and loosely enclosing the fruit, reticulate-veiny and 5-angled or 10-costate. Corolla rotate or rotate-campanulate, 5-angulate or obscurely 5-lobed. Berry juicy. Pedicels solitary.

* * Fruit a capsule.¹

4. **Nicotiana.** Corolla funnelliform or salverform. Filaments mostly included. Ovary normally 2-celled, with large and thick placenta, bearing very numerous ovules and seeds. The fruit more or less invested by the persistent calyx, septical and a.s. usually loculicidal at summit: the valves or teeth becoming 4.

1. SOLANUM, Tourn. NIGHTSHADE, etc.

Herbs of various habit: flowers cymose, mostly after the scorpioid manner.

* *Fruit naked, i. e. not enclosed in the enlarged calyx: stamens all alike, and anthers blunt.*

+ *Tuberiferous perennial, pinnate-leaved.*

i. **S. Jamesii**, Torr. A span or so in height: leaflets 5 to 9, varying from lanceolate to ovate-oblong, smoothish; the lowest sometimes much smaller, but no interposed small ones: peduncle cymosely few to several-flowered: corolla white, at length deeply 5-cleft. — Ann. Lyc. N. Y. ii. 227. Mountains of Colorado to New Mexico and Arizona. Very closely allied to *S. tuberosum*, var. *boreale*, Gr., of New Mexico and southward, the *S. Fendleri* of the earlier reports.

+ + *Annuals, simple-leaved, never prickly, but the angles of the stem sometimes rough.*

2. **S. triflorum**, Nutt. Green, slightly hairy or nearly glabrous, low and much spreading: leaves oblong, deeply pinnatifid, with wide rounded sinuses; the lobes 7 to 9, lanceolate, entire, or sometimes 1 or 2-toothed: peduncles lateral, 1 to 3-flowered: pedicels nodding: corolla small, white, a little longer than the 5-parted calyx: berries green, as large as a small cherry. — On the plains from New Mexico to the Saskatchewan, chiefly as a weed in cultivated ground.

3. **S. nigrum**, L. Low, green and almost glabrous, or the younger parts pubescent: leaves mostly ovate with a cuneate base, irregularly sinuate-toothed, repand, or sometimes entire, acute or acuminate: flowers in small pedunculate umbel-like lateral cymes: calyx much shorter than the corolla, which is white or bluish: berries usually black when ripe, only as large as peas. — Found everywhere, especially in damp or shady ground, and including many varieties.

* * *Fruit enclosed by the close-fitting and horridly prickly calyx and even adhering to it: stamens and especially the style much declined: anthers tapering upwards, dissimilar; the lowest one much longer and larger, and with an*

¹ The genus *Datura*, containing several introduced species within our range, may be recognized by its prismatic 5-toothed calyx, funnelliform corolla, and prickly mostly 4-celled 4-valved capsule. — They are rank weeds, with ovate leaves, and large and showy flowers on short peduncles in the forks of the branching stem. Known as "Jamestown Weed" or "Thorn Apple." For species see p. 270, foot-note.

incurved beak: leaves 1 to 3-pinnatifid: annuals, armed with straight prickles.

4. **S. heterodoxum**, Dunal. *Pubescent with glandular-tipped simple hairs, with a very few 5-rayed bristly ones on the upper face of the irregularly or interruptedly bipinnatifid leaves; their lobes roundish or obtuse and repand: corolla violet, 1½ inches or less in diameter, somewhat irregular, 5-cleft; the lobes ovate-acuminate: four anthers yellow and the large one tinged with violet.* — On the plains from Colorado to New Mexico and Texas.

5. **S. rostratum**, Dunal. *Somewhat hoary or yellowish with a copious wholly stellate pubescence, a foot or two high: leaves nearly as in the last or less divided, some of them only once pinnatifid: corolla yellow, about an inch in diameter, hardly irregular, the short lobes broadly ovate.* — On the plains from Nebraska to Texas and westward to the mountains.

2. CHAMÆSARACHA, Gray.

Depressed plants; with narrow entire or pinnatifid leaves tapering into margined petioles, filiform naked pedicels, the calyx close-fitting in fruit, almost globose.

1. **C. Coronopus**, Gray. *Green, almost glabrous, or beset with some short and roughish hairs, diffusely very much branched: leaves lanceolate or linear with cuneate-attenuate base, varying from nearly entire to lacinate-pinnatifid: peduncles elongated: calyx more or less hirsute, the hairs often 2-forked at tip: corolla yellowish: berry nearly white.* — Bot. Calif. i. 540. *Withania* (?) *Coronopus*, Torr. From S. Colorado to Texas and Arizona.

3. PHYSALIS, L. GROUND CHERRY.

Herbs, with entire, toothed, or lobed leaves, and solitary or sometimes 2 or 3 drooping or nodding pedicels: the flowers white, yellow, or violet-purple: berries greenish, red, or yellow.

* *Young parts sparsely (or on stalks and calyx densely) scurfy-granuliferous, otherwise quite glabrous: some leaves sinuate-pinnatifid: corolla flat-rotate.*

1. **P. lobata**, Torr. *Low and small, diffusely branched: leaves oblong-spatulate or obovate, from repand to sinuate-pinnatifid, the base cuneately tapering into a margined petiole: corolla violet, the centre with a 5 to 6-rayed white-woolly star.* — On the plains, from Colorado to Arizona and Texas.

* * *Not granulose-scurfy: leaves never pinnatifid: corolla mostly rotately spreading from a somewhat campanulate throat or base, greenish white or yellow.*

+ *Annuals, glabrous or nearly so, the pubescence if any minute, and neither viscid nor stellate: anthers violet: berry greenish yellow: stem and branches conspicuously angular.*

2. **P. angulata**, L. *Erect, or at length declined or spreading, 2 to 4 feet long: leaves mostly ovate-oblong and with somewhat cuneate base, coarsely and laciniately toothed: corolla 3 to 6 lines broad, with no distinct eye: fruiting calyx at first ovate-pyramidal and 10-angled, the 5 principal angles sharply keeled, at full maturity nearly replete and globose-ovate.* — From Colorado eastward to the Atlantic States.

— — *Strong-scented, villous or pubescent with viscid or glandular simple hairs: fruiting calyx ovate-pyramidal and carinately 5-angled at maturity, loosely enveloping the green or at length yellow berry: leaves ovate or cordate.*

3. **P. pubescens**, L. *Annual, a foot or two high, with at length widely spreading branches: leaves varying from nearly entire to coarsely and obtusely repand-toothed, sometimes becoming nearly glabrous except on the midrib and veins: corolla about $\frac{1}{2}$ inch in diameter when expanded, dull yellow with a purplish brown eye: anthers violet: pedicels 3 to 5 lines long: fruiting calyx mostly pubescent and viscid. — From California to Colorado and Texas, thence eastward to New York and Florida.*

4. **P. Virginiana**, Mill. *Perennial, a foot or so high, from slender and deep creeping subterranean shoots, at length spreading or decumbent, pubescent or hirsute-villous with many-jointed hairs: leaves either repandly or saliently few-toothed or some nearly entire: corolla from $\frac{3}{4}$ to 1 inch in diameter, dull sulphur-yellow with a brownish centre: anthers yellow: pedicels $\frac{1}{2}$ to 1 inch long. — *P. viscosa* of Gray's Manual. From Colorado eastward across the continent.*

— — — *Perennials, not viscid, the pubescence more or less stellular, mostly low: anthers almost always yellow.*

5. **P. Fendleri**, Gray. *Pruinose-puberulent: the pubescence microscopically minute and partly simple, partly branched or stellular, sometimes a little glandular: stems a span to a foot high from a deep tuberous stock, much branched: leaves small, from deltoid-ovate or slightly cordate to ovate-lanceolate, with abrupt base, and from repand-undulate to coarsely sinuate-toothed: corolla $\frac{1}{2}$ inch in diameter. — Proc. Am. Acad. x 65. S. Colorado and New Mexico.*

6. **P. lanceolata**, Michx. *More or less hirsute-pubescent with short and stiff tapering hairs, most of which are simple, a few 2 to 3-forked, varying to nearly glabrous: stems a span to a foot high, angled, somewhat rigid: leaves pale green, varying from oblong-ovate to narrowly lanceolate, acute at base or tapering into a short petiole, and from sparingly angulate-few-toothed to undulate or entire: corolla ochroleucous with more or less dark eye, $\frac{3}{8}$ to $\frac{1}{2}$ inch in diameter. — *P. Pennsylvanica*, Gray Man., in part. On the plains from New Mexico, Colorado, and Utah, eastward to Florida and Lake Winnipeg.*

Var. lævigata, Gray. *Glabrous or almost so throughout, or with some extremely short and pointed appressed rigid hairs on young parts, calyx, etc., or on the margin of the leaves. — From Nebraska to Texas and westward to New Mexico and Arizona.*

4. NICOTIANA,¹ Tourn. TOBACCO.

Heavy-scented and usually viscid-pubescent herbs; with mostly entire leaves, and paniculate or racemose flowers.

¹ The two introduced species of *Datura* may be distinguished as follows: —

D. Stramonium, L., the common Jamestown (vulgarized to "Jimson") Weed, is green and glabrous, 1 to 4 feet high; has sinuately and laciniately angled and toothed leaves, a white corolla about 3 inches long, and an erect capsule thickly armed with short stout prickles.

D. discolor, Bernh., probably from Mexico, is low and more or less cinereous-pubescent; has leaves like the last, but the white corolla is tinged with purple and perhaps smaller, and the nodding globose capsule and its stout large prickles are pubescent.

1. **N. attenuata**, Torr. A foot or two high: *leaves all on naked and mostly slender petioles* and acute or merely obtuse at base; the lower ovate or oblong; the upper from oblong-lanceolate and attenuate-acuminate to linear-lanceolate or linear: *corolla* dull white or greenish, *slender salverform, not enlarged at the throat*; the tube 1 to $1\frac{1}{2}$ inches long; the *obscurely 5-lobed limb* 4 to 6 lines in diameter: *filaments equally inserted low down on the tube*.—In dry ground, from Colorado to Nevada and California.

2. **N. quadrivalvis**, Pursh. A foot high, rather stout: leaves oblong or the uppermost lanceolate, and the lower ovate-lanceolate, acute at both ends, *mostly sessile*; flowers few: *corolla* white, *tubular-funnelform and open-mouthed*; the tube barely an inch long; the *5-lobed limb* $1\frac{1}{2}$ inches or more in diameter: *filaments unequally inserted in the upper part of the tube*: capsule 4-celled.—A native of Oregon, but cultivated by the Indians to the Missouri: their most prized tobacco-plant.

ORDER 56. SCROPHULARIACEÆ. (FIGWORT FAMILY.)

Chiefly herbs with didynamous or diandrous stamens inserted on the tube of the 2-lipped or more or less irregular corolla: fruit a 2-celled and usually many-seeded pod. Style single: stigma entire or 2-lobed.

I. Leaves prevailingly opposite, at least the lower: upper lips or lobes of the corolla external in the bud. — ANTIRRHINIDÆ.

* Corolla bilabiate and more or less tubular; the base of the tube gibbous or spurred on the lower side, and the lower lip often with an intrusion (palate) at the throat: stamens 4, with 2-celled anthers: capsule opening by irregular perforations or chinks: inflorescence simple and racemose.

1. **Linaria**. Corolla with a spur at base and a prominent palate nearly closing the throat.

* * Corolla more or less bilabiate and tubular, not saccate or otherwise produced at base anteriorly: stamens 4, with usually a rudiment of the fifth present: capsule dehiscent by valves; inflorescence normally compound.

← Corolla gibbous or saccate on the upper or posterior side of the tube: ovules and seeds few or solitary in the cells: calyx deeply 5-cleft: flowers solitary or umbelliform-verticillate.

2. **Collinsia**. Corolla deeply bilabiate; its upper lip 2-cleft, with lobes more or less erect; lower larger and 3-lobed; its lateral lobes pendulous-spreading; middle one conduplicate into a keel-shaped sac which encloses the 4 declined stamens and style. Anterior pair of filaments inserted higher than the other: anther-cells confluent at the apex. A gland at base of corolla represents the fifth stamen. Leaves undivided.

← ← Corolla-tube not gibbous posteriorly: ovules and seeds indefinitely numerous: calyx deeply 5-parted or of distinct sepals: inflorescence mostly thyrsoïdal.

3. **Scrophularia**. Corolla short; the tube ventricose and globular or oblong: lobes 5, unequal, 4 erect and the fifth reflexed or spreading. Sterile stamen represented by a scale on the upper side of the corolla: anthers transverse and confluent 1-celled.

4. **Pentstemon**. Corolla from ventricose campanulate to elongated-tubular; the limb either obscurely or strongly bilabiate. Sterile stamen represented by a conspicuous and elongated filament: anther-cells either united or confluent at apex.

← ← ← Corolla-tube not gibbous: ovules and seeds rather numerous: calyx not deeply cleft: inflorescence simply spicate.

5. **Chionophila**. Calyx funnelform. Corolla tubular, with slightly dilated throat and bilabiate limb; upper lip erect, barely 2-lobed, the sides somewhat recurved; lower

with convex densely bearded base forming a palate, and 3-lobed. Sterile filament small and short: anther-cells divaricate and confluent.

- * * * Corolla from bilabiate to almost regular, not saccate or otherwise produced at base: antheriferous stamens 2 or 4, with no rudiments of the fifth: capsule dehiscent, many-seeded: inflorescence simple; the pedicels solitary in the axil of bracts or leaves.

+ Calyx prismatic and barely 5-toothed: corolla more or less bilabiate: stamens 4.

6. **Mimulus**. Corolla with either elongated or short tube; upper lip 2-lobed, and the lower 3-lobed; a pair of palatine ridges running down the lower side of the throat. Anthers generally approximate in pairs; their cells divergent.

+ + Calyx 5-parted or deeply 4 to 5-lobed: corolla bilabiate: antheriferous stamens 2.

7. **Gratiola**. Corolla with cylindraceous tube and lips of nearly equal length; the upper entire or lobed; the lower 3-cleft. The posterior pair of stamens antheriferous; the anterior pair sterile rudiments.

+ + + Calyx and corolla both 5-lobed and nearly regular: stamens 4, nearly equal: no sterile filament.

8. **Limosella**. Calyx campanulate. Corolla between rotate and campanulate. Anthers one-celled by confluence.

II. Leaves various: lower lip or lateral lobes of the corolla external in the bud.

- * Corolla little if at all bilabiate; the lobes all plane, the lateral or one of them external: stamens 2, exserted: anther-cells contiguous at apex and often confluent: hypogynous disk mostly conspicuous: none parasitic.

9. **Synthyris**. Corolla from oblong- to short-campanulate, 4-cleft, more or less irregular, occasionally wanting. Sepals 4. Anther-cells parallel or divergent below, not confluent at apex. Capsule emarginate.

10. **Veronica**. Corolla (in ours) rotate with very short or hardly any tube; its lobes 4 (sometimes 5), one usually smaller. Anther-cells more or less confluent. Capsule compressed, from emarginate to obcordate or 2-lobed.

- * * Corolla little or not at all bilabiate; the lobes all plane, the anterior one external: stamens 4, conspicuously didynamous, shorter than the corolla; anther-cells distinct to the very apex: most of them partially root parasitic; the foliage turning black in drying.

11. **Gerardia**. Corolla from campanulate to funnelliform; the throat enlarged: limb 5-parted, and with the 2 posterior lobes often rather smaller or more united. Calyx campanulate, 5-toothed or 5-cleft. Anthers more or less approximate in pairs.

- * * * Corolla manifestly bilabiate; the upper lip erect and concave or galeate, entire or emarginate, rarely 2-cleft; the lower 3-cleft, external in the bud: stamens 4 and didynamous, or rarely 2, ascending under the upper lip; anther-cells distinct: some of them partially root-parasitic.

- + Anther-cells unequal or dissimilar; the outer one affixed by its middle; the other pendulous from its upper end, mostly smaller, sometimes sterile or deficient: leaves alternate or only the lowest opposite.

12. **Castilleja**. Calyx tubular, laterally flattened, more or less cleft anteriorly or posteriorly, or both. Corolla tubular, more or less laterally compressed, especially the elongated and conduplicate or carinate-concave and entire upper lip; lower lip short and small, 3-toothed, 3-carinate or somewhat saccate below the teeth; the tube usually enclosed in the calyx. Stamens 4, all with 2-celled anthers.

13. **Orthocarpus**. Calyx tubular-campanulate, 4-cleft, or cleft anteriorly and posteriorly and the divisions 2-cleft or parted. Corolla mostly with slender tube; upper lip little longer and usually much narrower than the inflated 1 to 3-saccate lower one. Stamens 4: the smaller anther-cell sometimes wanting.

14. **Cordylanthus**. Calyx spatheaceous, diphyllous, or by the absence of the anterior division monophyllous. Corolla tubular, with lips commonly of equal length; the upper as in *Orthocarpus*; the lower 3-crenulate or entire. Stamens 4, or sometimes the shorter pair wanting: anther-cells either ciliate or minutely bearded at base and apex. Style hooked at tip.

← ← Anther-cells equal, parallel and alike in all 4 stamens.

15. **Pedicularis.** Calyx various, cleft anteriorly and sometimes posteriorly. Corolla with cylindraceous tube and narrow throat, strongly bilabiate; upper lip compressed laterally, fornicate or conduplicate; lower erect at base, 2-cristate above, 3-lobed; the lobes spreading or reflexed, the middle one smaller. Capsule compressed and often oblique or falcate, rostrate. Leaves mainly alternate or verticillate.
16. **Rhinanthus.** Calyx ventricose-compressed, 4-toothed, inflated in fruit. Corolla with cylindraceous tube; galeate upper lip ovate, obtuse, compressed, entire at apex, but with a minute tooth on each side below it; lower lip shorter, with 3 spreading lobes. Capsule orbicular, compressed. Leaves opposite.

1. LINARIA, Tourn. TOAD-FLAX.

Herbs: calyx 5-parted: leaves entire and mostly linear: flowers in a naked terminal raceme.

1. **L. Canadensis**, Dumont. Flowering stems nearly simple, 6 to 30 inches high: leaves flat, alternate on the erect flowering stems, smaller and oblong and mainly opposite or whorled or procumbent shoots or suckers from the base: pedicels erect, not longer than the filiform and curved spur of the small blue corolla. — Across the continent, in sandy soil.

2. COLLINSIA, Nutt.

Low; with simple opposite sessile leaves, or the upper verticillate: flowers solitary or umbelliform-verticillate: corolla often 2-colored.

1. **C. parviflora**, Dougl. About a span high, at length diffuse or spreading: leaves oblong or lanceolate; the upper narrowed at base and entire; the floral often in whorls of 3 to 5: pedicels solitary or above 2 to 5 in the whorl: calyx-lobes lanceolate or triangular-subulate, usually almost equalling the blue (or partly white) corolla: gland small, capitate, short-stipitate. — From Arizona and Utah to Washington and Michigan.

3. SCROPHULARIA, Tourn. FIGWORT.

Usually tall and homely herbs; with opposite leaves and loose cymes of small flowers in a narrow terminal thyrsus.

1. **S. nodosa**, L. Nearly glabrous, 2 or 3 feet high: thyrsus elongated and open: leaves ovate or oblong-ovate, acute, with a rounded or subcordate base, sharply and often doubly serrate: rudiment of fifth stamen orbicular.

Var. **Marilandica**, Gray. Taller, sometimes 5 feet high: leaves larger and thinner, acuminate, often ovate-lanceolate, seldom at all cordate, mostly simply serrate. — Synopt. Fl. ii. 258. From Oregon and Utah eastward across the continent.

4. PENTSTEMON, Mitchell. BEARD-TONGUE.

Usually with simple stems or branched from the base: the leaves opposite, rarely verticillate: inflorescence from thyrsiform to almost simply racemose, and the flowers mostly showy.

§ 1. *Anther-cells soon divaricate or divergent, united and often confluent at the apex, dehiscent for their whole length or nearly.*

* *Anthers densely comose with very long wool, peltately explanate in age: low and suffruticose, with coriaceous leaves.*

1. **P. Menziesii**, Hook. From a few inches to a foot high: leaves commonly ovate, obovate, or oblong, $\frac{1}{4}$ to 1 inch long, rigidly serrulate or some entire, glabrous or when young pubescent: inflorescence mostly glandular or viscid-pubescent, racemose: pedicels almost all 1-flowered: corolla violet-blue to pink-purple, an inch or more long, tubular-funnelform and moderately bilabiate: sterile filament short and slender, hairy at apex or nearly naked. — On rocks and in the mountains, from Wyoming to California and northward.

* * *Anthers glabrous (rarely villous); the cells dehiscent from the base towards but not to the apex: corolla tubular, red: sterile filament mostly glabrous: herbs glabrous and usually glaucescent: leaves all entire; the cauline sessile or partly clasping: thyrsus elongated, loosely-flowered.*

2. **P. barbatus**, Nutt. Usually tall, 2 to 6 feet high: leaves lanceolate or the upper linear-lanceolate; the lowest oblong or ovate: sepals ovate: corolla strongly bilabiate, an inch long, from light pink-red to carmine; base of the lower lip or throat usually bearded with long and loose or sparse yellowish hairs. — Mountains of Colorado and New Mexico.

Var. **Torreyi**, Gray. A tall and usually deep scarlet-red-flowered form, with few or no hairs in the throat. — Bot. Mex. Bound. 114. From Colorado and New Mexico to W. Texas.

Var. **trichander**, Gray, is like a low form of var. *Torreyi*, except that the anthers are beset with long woolly hairs. — Proc. Am. Acad. xi. 94. S. W. Colorado, Brandegee.

3. **P. Eatoni**, Gray. A foot or two high: leaves from lanceolate to ovate; the upper partly clasping: *peduncles very short*, 1 to 3-flowered: corolla obscurely bilabiate, an inch long, bright carmine-red; its lobes all nearly alike. — Proc. Am. Acad. viii. 395. From the Wasatch Mountains, Utah, to Nevada and Arizona.

* * * *Anthers with the diverging or divaricate and distinct cells dehiscent from base nearly or quite to the apex, but not confluent, not peltately explanate after dehiscence, either glabrous, hirsute, or pilose: herbs with simple stems and closely sessile glabrous entire cauline leaves: inflorescence never glandular-pubescent or viscid: flowers showy: corolla blue or violet.*

4. **P. Fremonti**, Torr. & Gray. A span or more high, minutely and densely pruinose-pubescent: cauline leaves lanceolate or the lowest and radical spatulate: thyrsus spiciform, virgate, rather densely flowered: sepals oblong-ovate, acute, with irregular scarious margins: corolla very obscurely bilabiate, funnelform, $\frac{2}{3}$ to $\frac{3}{4}$ inch long, with throat but little dilated: anthers hirsute: sterile filament with dilated bearded apex. — Proc. Am. Acad. vi. 60. "On the Uinta plains," Utah, Fremont.

Var. **subglaber**, Gray. Merely puberulent below, glabrous above: upper leaves oblong-lanceolate: sepals conspicuously acuminate. — Synopt. Fl. ii. 262. In the mountains near Fort Hall, Idaho, etc.

5. **P. strictus**, Benth. *Glabrous, or minutely pruinose, more or less glaucous: stem slender, 6 to 20 inches high: radical leaves from oval to spatulate; cauline narrowly lanceolate or linear; floral reduced to small subulate bracts of the elongated narrow and loose thyrsus: sepals ovate or oval, obtuse: corolla about an inch long; the throat strongly ampliate: anthers either thickly or sparsely comose with very long flexuous hairs: sterile filament naked or with some similar slender hairs.*—Mountains of W. Wyoming to S. W. Utah.

6. **P. glaber**, Pursh. *Glaucous or glaucescent and very glabrous: stems a foot or two high: leaves mostly oblong-lanceolate or the upper ovate-lanceolate: thyrsus elongated and many-flowered: sepals from orbicular-ovate and merely acute to ovate-lanceolate or strongly acuminate from a broadish base: corolla 1 to 1½ inches long, the throat ampliate: anthers from glabrous to sparsely hirsute.*—From Nebraska and the Dakotas to Colorado, Arizona, and west to Oregon and California.

Var. **alpinus**, Gray. *A span high: cauline leaves from narrowly to broadly lanceolate: thyrsus shortened and few-flowered.*—Alpine regions from the Yellowstone to Pike's Peak.

Var. **cyananthus**, Gray. *Usually tall: leaves all broad; the cauline ovate or subcordate and ovate-lanceolate: thyrsus dense: sepals much acuminate or narrow: anthers and sterile filament from hirsute to nearly glabrous.*—Proc. Am. Acad. vi. 60. *P. cyananthus*, Hook. Wyoming and Colorado to the Wasatch in Utah.

* * * * *Anthers dehiscent from base to apex and confluent, glabrous, explanate after dehiscence: herbs or rarely suffrutescent at base.*

+ *Glabrous throughout even to pedicels and calyx: leaves all entire, from linear to ovate, glaucous or pale: stems simple and erect: thyrsus virgate or contracted: corolla less than an inch long.*

++ *Corolla abruptly campanulate-inflated, rather strongly bilabiate.*

7. **P. secundiflorus**, Benth. *A foot or two high, including the elongated and racemiform strict many-flowered thyrsus: cauline leaves narrowly lanceolate; radical spatulate: peduncles 1 to 3-flowered: sepals ovate or oblong, with somewhat scarious but entire margins: corolla with narrow proper tube nearly twice the length of the calyx: sterile filament glabrous or minutely bearded at the dilated tip.*—Mountains of Colorado.

8. **P. Hallii**, Gray. *Resembling the last, but lower: leaves thickish, linear and linear-spatulate: thyrsus short and more spiciform, 5 to 15-flowered, obscurely viscid: sepals broadly ovate and with widely scarious erose margins: corolla with thickish and inconspicuous proper tube shorter than the calyx: sterile filament short-bearded from apex downward.*—Proc. Am. Acad. vi. 71. Mountains of Colorado, at 10,000 to 12,000 feet.

++ ++ *Tube of corolla gradually and moderately dilated into the funnel-form throat; lobes obscurely bilabiate.*

9. **P. acuminatus**, Dougl. *Glaucous, 6 to 20 inches high, generally stout and rigid, leafy: leaves coriaceous; radical and lowest cauline obovate or oblong; upper cauline from lanceolate to broadly ovate, or the upper cordate-clasping, these mostly acute or acuminate: thyrsus strict, interrupted, leafy below, naked above: sepals ovate and acute or lanceolate: corolla lilac or changing*

to violet: sterile filament mostly bearded at the dilated tip. — From the Saskatchewan and Upper Missouri to Oregon, New México, and W. Texas.

10. **P. cæruleus**, Nutt. Like the last, but *low: leaves all from lanceolate to narrowly linear: thyrsus spiciform and usually dense: sepals lanceolate-acuminate: corolla blue, varying occasionally to rose-lilac or white: sterile filament much bearded above.* — Plains of the Dakotas and Montana to Colorado.

+ + *Puberulent or pubescent and above viscid or glandular: leaves from oblong to lanceolate-linear, entire or the margins undulate: thyrsus racemiform: corolla ample, purplish; its tube little if any longer than the sepals, abruptly dilated into the campanulate or broadly funnelform throat.*

11. **P. Jamesii**, Benth. *Pruinose-puberulent: leaves all narrowly or linear-lanceolate: corolla abruptly dilated into a broadly cyathiform-campanulate throat, a little hairy within: sterile filament moderately bearded.* — Prairies, S. Colorado to New Mexico and W. Texas

12. **P. cristatus**, Nutt. *Pubescent, or above viscid villous: leaves from linear-lanceolate to narrowly oblong: corolla more funnelform, being less abruptly dilated; its lower lip long-villous within: sterile filament more exerted, inordinately yellow-bearded.* — From the Dakotas to Nevada and S. Colorado.

+ + + *Puberulent or viscid-pubescent, at least the inflorescence, or sometimes glabrous: leaves various: corolla from 4 lines to an inch long, not abruptly campanulate-ventricose above: sepals usually narrow or acuminate.*

+ + *Leaves from ovate to lanceolate, undivided: stems erect or ascending: thyrsus mostly many-flowered.*

= *Corolla hardly at all bilabiate, funnelform, with widely spreading lobes, whitish or tinged with purple.*

13. **P. albidus**, Nutt. *Viscid-pubescent, 6 to 10 inches high: leaves oblong lanceolate or narrow, entire or sparingly denticulate: thyrsus strict, leafy below, of approximate few to several-flowered clusters: sepals densely viscid-pubescent, 3 or 4 lines long: corolla with shorter tube, the rather ample limb about as broad.* — On the plains from the Dakotas to Colorado and Texas.

14. **P. deustus**, Dougl. *Completely glabrous, or the calyx obscurely glandular, a span to a foot high in tufts from a woody base, rigid: leaves coriaceous, from ovate to oblong-linear or lanceolate, irregularly and rigidly dentate or acutely serrate, or some of them entire: thyrsus virgate or more paniculate, mostly many-flowered: corolla narrowly or broadly funnelform, half-inch or less long.* — In the interior from California to British Columbia and eastward into Montana.

= = *Corolla more plainly bilabiate; lower lip usually somewhat bearded or pubescent within.*

15. **P. confertus**, Dougl., var. **cæruleo-purpureus**, Gray. *Glabrous throughout, or the inflorescence and calyx viscid-pubescent or puberulent, from 2 inches to 2 feet high: leaves from oblong or oblong-lanceolate to somewhat linear, usually entire: thyrsus spiciform, interrupted, naked, of 2 to 5 dense verticillate flower clusters, or in the low mountain forms with capitulum inflorescence: pedicels very short: sepals variable, usually broad, commonly very scarious and erose, sometimes with a long herbaceous acumination: corolla narrow, 4 to 6 lines long, blue-purple and violet; lower lip conspicu-*

ously bearded within. — Mountains of Colorado and northward, thence westward to Oregon and through the Sierra Nevada.

16. **P. Watsoni**, Gray. Glaucous and glabrous throughout, or inflorescence and calyx puberulent, but not viscid, a foot or more high: cauline leaves oblong-lanceolate to ovate-lanceolate, acute or acuminate, entire or denticulate: *contracted thyrsus rather loose*: pedicels longer than the calyx: *sepals broadly ovate or orbicular*, somewhat scarious-margined: corolla narrowly funnelform, 6 to 8 lines long, violet-purple or partly white; *lower lip almost glabrous within*. — Synopt. Fl. ii. 267. *P. Fremonti*, var. *Parryi*, Gray. Mountains of W. Colorado, Utah, Nevada, and Arizona.

17. **P. humilis**, Nutt. Glabrous or *viscid-pubescent above*, a span or two high: leaves glaucous, from oblong to lanceolate: *the cauline commonly denticulate*: *thyrsus strict and virgate*, 2 to 4 inches long: pedicels short: *sepals ovate or lanceolate and acuminate*: corolla narrowly funnelform, half-inch long, deep-blue or partly white; *lower lip somewhat hairy within*. — In the mountains from S. Colorado to the British boundary and westward.

Var. **brevifolius**, Gray. A low and diffuse tufted form, with weak stems: leaves at most half-inch long; cauline elliptical-oblong; the radical oval or rotund: corolla light blue. — Synopt. Fl. ii. 267. In the Wasatch Mountains of Utah at 9,000 or 10,000 feet elevation.

18. **P. gracilis**, Nutt. A foot or less high, glabrous or merely puberulent up to the *more or less viscid-pubescent strict thyrsus*: stems slender: *cauline leaves mostly linear-lanceolate*, sometimes denticulate; *the radical spatulate or oblong*: cymes of the thyrsus pedunculate: *sepals lanceolate, acute, marginless*: corolla tubular-funnelform or almost cylindraceous, lilac-purple or sometimes whitish, $\frac{3}{4}$ to 1 inch long; the throat open. — *P. pubescens*, var. *gracilis*, Gray. From Colorado to Wyoming and the Saskatchewan.

19. **P. glaucus**, Graham. Glabrous up to the inflorescence, more or less glaucous: stems dwarf or ascending, a span to a foot high: *leaves thickish, oblong-lanceolate* or the radical oblong-ovate, entire or denticulate: *thyrsus short and compact, either simple or compound, villous-pubescent and viscid or glandular*: corolla dull lilac or violet-purple, less than an inch long, *swollen above the short tube, gibbous*; the throat widely open; the broad lower lip sparsely villous-bearded within. — Mountains of Wyoming, Utah, and far northward.

Var. **stenosepalus**, Gray. Sometimes over a foot high: thyrsus comparatively small and glomerate: sepals attenuate-lanceolate: corolla dull whitish or purplish. — Mountains of Colorado and Utah.

++ ++ *Leaves from linear-spatulate to obovate, entire: stems low-cespitose spreading, leafy to the summit, few-flowered.*

= *Leaves green and mostly glabrous, $\frac{1}{4}$ to $\frac{1}{2}$ inch wide.*

20. **P. Harbournii**, Gray. Tufted nearly simple stems 2 to 4 inches high, puberulent: leaves about 3 pairs, thickish, obovate, oval, or the uppermost ovate, these sessile by a broad base: thyrsus reduced to 2 or 3 crowded short-pedicelled flowers: sepals villous and somewhat viscid: corolla little bilabiate, with rather broad cylindraceous throat and tube; lower lip bearded within. — Proc. Am. Acad. vi. 71. High alpine region of the Colorado Mountains.

= = *Leaves cinereous or canescent, 1 or 2 lines wide: flowering along the short stems in the axils of the leaves: short peduncles 1 to 3-flowered.*

21. *P. pumilus*, Nutt. *Canescent with a dense and fine short pubescence: stems an inch or two high, erect or ascending, very leafy: leaves lanceolate or the lower spatulate: corolla with regularly funnelform throat, glabrous within: sterile filament sparsely short-bearded, or more abundantly at the tip.*—Mountains of Montana, Wyeth.

22. *P. cæspitosus*, Nutt. *Minutely cinereous-puberulent, spreading, forming depressed broad tufts 2 to 4 inches high: leaves from narrowly spatulate to almost linear: peduncles mostly secund and horizontal, but with the flower upturned: corolla tubular-funnelform, and the lower side biplicate, the narrow folds sparsely villous within: sterile filament strongly and densely bearded.*—Mountains of Wyoming, Colorado, and Utah.

++ ++ ++ *Leaves from narrowly linear-lanceolate with tapering base or linear-spatulate to filiform, entire: stems or branches racemously several to many-flowered.*

23. *P. laricifolius*, Hook. & Arn. *Glabrous: stems or tufted branches simple from an underground woody base: leaves very slender, when dry filiform, much crowded in subradical tufts and scattered on the filiform flowering stems: short peduncles alternate: flowers few, loosely racemose: corolla tubular-funnelform, half-inch long; the small limb obscurely bilabiate: sterile filament longitudinally bearded.*—Wyoming and Oregon.

24. *P. ambiguus*, Torr. *Glabrous, a foot or two high, diffuse and often much branched: leaves filiform, or the lowest linear and the floral slender-subulate: inflorescence loosely paniculate: peduncles slender, opposite, the upper one-flowered: corolla rose-color and flesh-color becoming white; the rotately expanded limb oblique but obscurely bilabiate; lobes orbicular-oval; throat somewhat hairy: sterile filament glabrous, sometimes imperfectly antheriferous.*—Plains of E. Colorado and New Mexico to S. Utah and Arizona.

§ 2. *Anthers sagittate or horseshoe-shaped; the cells confluent at the apex, and there dehiscent by a continuous cleft, which extends down both cells only to the middle; the base remaining closed and saccate. In ours the sterile filament is glabrous.*

* *Corolla blue to purple, ventricose-funnelform, short-bilabiate, $\frac{2}{3}$ to $1\frac{1}{2}$ inches long: inflorescence, calyx, etc. glabrous.*

25. *P. Kingii*, Watson. *Hardly glaucous: stems a span or so high from the depressed woody base, leafy to the top, erect or ascending: leaves oblanceolate or lanceolate-linear, mostly narrowed to the base: thyrsus strict, 1 to 5 inches long: corolla $\frac{2}{3}$ inch long, purple.*—Synopt. Fl. ii. 272. Uinta and Wasatch Mountains and westward.

26. *P. azureus*, Benth. *Glaucous, rarely pruinose-puberulent: stems erect or ascending, 1 to 3 feet high: leaves from narrowly to ovate-lanceolate or even broader: thyrsus virgate, loose, usually elongated: corolla from 1 to $1\frac{1}{2}$ inches long, azure-blue to violet, the base sometimes reddish; the expanded limb sometimes an inch in diameter.*

Var. *Jaffrayanus*, Gray. *A low form: leaves oblong or oval, or the upper ovate-lanceolate or ovate, very glaucous: peduncles 1 to 5-flowered:*

flowers large. — Bot. Calif. ii. 567. From the Wahsatch Mountains westward to California.

Var. **ambiguus**, Gray. A rather tall form, paniculately branched and slender, with lanceolate and linear leaves all narrowed at base, pale and glaucescent, and the corolla violet-blue, an inch or less long: sepals remarkably small. — Synopt. Fl. ii. 272. *P. heterophyllus*, Watson. Cañons of the Wahsatch Mountains and westward.

* * *Corolla scarlet-red, tubular-funnelform, conspicuously bilabiate, an inch long.*

27. **P. Bridgesii**, Gray. A foot or two high from a woody base, glabrous up to the virgate secund thyrsus, or puberulent: leaves from spatulate-lanceolate to linear; the floral reduced to small subulate bracts: peduncles, pedicels, and sepals glandular-viscid: lips of the narrow corolla fully a third the length of the tube; the upper erect and 2-lobed; the lower 3-parted and its lobes recurved. — Proc. Am. Acad. vii. 379. S. W. Colorado, *Brandegee*, and westward into S. California.

5. CHIONOPHILA, Benth

A high alpine dwarf perennial, with entire leaves mostly in a radical tuft and a dense spike of cream-colored flowers.

1. **C. Jamesii**, Benth. Glabrous or nearly so: leaves thickish, spatulate or lanceolate, tapering into a scarious sheathing base; those on the scape-like flowering stems one or two pairs, or occasionally alternate, linear: spike few to many-flowered, mostly secund, bracteate: corolla over a half-inch long, dull cream-color. — Gray in Am. Jour. Sci. II. xxxiii. 254. Alpine regions of the Colorado mountains.

6. MIMULUS, L. MONKEY-FLOWER.

Flowers usually showy and axillary, or becoming racemose by the reduction of the upper leaves to bracts.

* *Viscid or glandular-pubescent.*

+ *Leaves sessile or nearly so, entire or few-toothed: corolla rose-purple or yellow.*

1. **M. nanus**, Hook. & Arn. From an inch to a span or more high: leaves from obovate or oblong to lanceolate: calyx-teeth broadly lanceolate or triangular, a quarter of the length of the tube: corolla $\frac{1}{2}$ to $\frac{3}{4}$ inch long, funnelform, with widely spreading limb and throat gradually narrowed downward into the included or partly exerted tube: stigma peltate-funnelform: capsules with tapering apex rather exceeding the calyx. — Ranging chiefly west of our limit, but extending eastward into Wyoming.

2. **M. rubellus**, Gray. From 2 to 10 inches high, branched from the base: leaves from spatulate-oblong to linear, $\frac{1}{4}$ to $\frac{3}{4}$ inch long, commonly equalling the pedicels; the lower sometimes obovate or ovate: calyx-teeth short and obtuse: corolla 3 or 4 lines long, from a third to twice the length of the calyx, yellow or rose-color, sometimes yellow varying or changing to crimson-purple; the throat broad and open: stigma bilamellar. — From New Mexico and Arizona to Colorado and Washington.

+ + *Leaves petioled, denticulate or serrate: corolla narrow, light yellow.*

3. **M. floribundus**, Dougl. About a span high, flowering from almost the lowest axils, the lateral branches diffusely spreading: leaves ovate and the lower subcordate, an inch long or less; the upper shorter than the somewhat racemose pedicels: calyx short-campanulate, becoming ovate or oblong and truncate in fruit; the teeth short and triangular: corolla 3 to 6 lines long: capsule globose-ovate, obtuse. — From the mountains of Colorado and Wyoming to California and Oregon.

4 **M. moschatus**, Dougl. More villous and viscid, musk-scented: stems spreading and creeping, a foot or so long: leaves oblong-ovate, an inch or two long, mostly exceeding the pedicels: calyx short-prismatic, becoming oblong-campanulate in fruit; the teeth broadly lanceolate and acuminate: corolla usually $\frac{3}{4}$ inch long: capsule ovate, acute. — From W. Wyoming to California and British Columbia. Known as the "Musk Plant."

* * *Neither viscid nor glandular.*

+ *Corolla rose-red: calyx oblong-prismatic; the short teeth nearly equal.*

5. **M. Lewisii**, Pursh. Slender, 2 to 4 feet high, with minute or fine pubescence: leaves from oblong-ovate to lanceolate, denticulate: corolla $1\frac{1}{2}$ to 2 inches long; the roundish lobes all spreading: stamens included. — Throughout the Sierra Nevada and extending eastward into Montana and Utah.

+ + *Corolla yellow: calyx campanulate, oblique at the orifice; the posterior tooth largest.*

6. **M. Jamesii**, Torr. & Gray. Diffuse and creeping, glabrate: leaves roundish and often reniform, from denticulate to nearly entire, 4 to 12 lines long, all but the uppermost with margined petioles: flowers all axillary and slender-pedicelled: corolla light yellow, 4 to 6 lines long: fructiferous calyx campanulate, 3 lines long: seeds shining, almost smooth. — In water or wet places, in the mountains from Arizona to Montana and eastward to Illinois and Michigan.

7. **M. luteus**, L. Glabrous or puberulent: stems erect; the larger forms 2 to 4 feet high: leaves ovate, oval-oblong, roundish, or subcordate; the upper cauline and floral smaller, closely sessile, not rarely connate-clasping; all usually acutely dentate or denticulate; lower sometimes lyrate-laciniate: inflorescence chiefly racemose or terminal: corolla deep yellow, commonly dark-dotted within, and the protuberant base of lower lip blotched with brown-purple or copper-color, sometimes 1 to 2 inches long: calyx ventricose-campanulate, a half-inch or less long: seeds rather dull, longitudinally striate-reticulate. — Throughout the Rocky Mountains and westward. Immensely variable.

Var. **alpinus**, Gray. A span or so high: stem 1 to 4-flowered: some leaves rather distinctly pinnate-veined above the middle. — Proc. Acad. Philad. 1863, 71. From the Colorado mountains and California Sierras to Alaska.

Var. **depauperatus**, Gray. Includes reduced or depauperate forms, 2 to 10 inches high, with leaves 3 to 6 lines long, fruiting calyx 2 or 3 lines long, and corolla 3 to 7 lines long. — Bot. Calif. i. 567. Rocky Mountains and westward.

7. GRATIOLA, L. HEDGE HYSSOP.

Soft-herbaceous and diffusely branching plants, from a creeping base, growing in wet soil: pedicels solitary and axillary, with a pair of foliaceous bractlets close to the calyx and equalling it.

1. *G. Virginiana*, L. Viscid-puberulent or more pubescent, or below nearly glabrous, divergently branched from the base, a span or less high: leaves commonly glabrous, oblong-lanceolate, acute, from entire to denticulate-serrate, mostly narrow at base: corolla 4 or 5 lines long, with yellowish tube barely twice the length of the calyx; lobes nearly white, the two upper emarginate. — Across the continent.

8. LIMOSELLA, L. MUDWORT.

Small, glabrous plants, with fibrous roots and a cluster of entire fleshy leaves at the nodes of the stolons, and short scape-like naked pedicels from the axils, bearing a small and white or purplish flower.

1. *L. aquatica*, L. Tufts an inch or two high: clustered leaves longer than the pedicels, when scattered on sterile shoots alternate, in the typical form with a spatulate or oblong blade on a distinct petiole; this in mud rather short, in water elongating to the length of 2 to 5 inches. — From Hudson Bay to S. Colorado, and westward to the Sierras.

9. SYNTHYRIS, Benth.

Leaves largely radical and petioled; those of the simple stem or scape and the bracts alternate: flowers small, purplish or flesh-color, in a simple spike or raceme. In ours the flowers are in a dense spike terminating a stouter leafy scape or stem.

* *Leaves laciniately cleft or divided, all radical: corolla cylindraceous, 4-cleft to the middle.*

1. *S. pinnatifida*, Watson. Tomentulose-pubescent and glabrate: leaves slender-petioled, from round-reniform to oblong in outline, from palmately to pinnately 3 to 7-parted or below divided, and the divisions again laciniately cleft or parted: scape sparingly bracteate, a span high: spike narrow: corolla whitish. — Bot. King Exp. 227. In the Wasatch Mountains of Utah and probably extending eastward in the mountains.

* * *Leaves undivided, merely crenate or crenulate: scape or stem leafy-bracteate.*

+ *Corolla mostly 2-parted, rarely 3-parted, and stamens inserted on its very base.*

2. *S. alpina*, Gray. A span or only an inch or two high, early glabrate except the very lanuginous inflorescence: radical leaves oval or subcordate, an inch or so long on a longer petiole: base of scape naked: bracts and lanceolate sepals very long-woolly-villous at margins: corolla violet-purple; its broad upper lip twice the length of the calyx, the 2 to 3-parted lower one small and included. — Am. Jour. Sci. 11. xxxiv. 251. In the alpine region of the Colorado Rocky Mountains.

3. **S. plantaginea**, Benth. A foot or less high, rather stout: tomentulose-pubescent when young: radical leaves oblong, rarely cordate, usually obtuse at base, 2 to 4 inches long: scape very leafy-bracteate: spike 3 to 5 inches long: bracts and ovate sepals glabrate and villous-ciliate: corolla purplish; its upper lip little exceeding the calyx, twice the length of the 2 to 3-lobed lower one. — Mountains of Colorado and New Mexico, in subalpine woods.

← ← Corolla wanting: stamens inserted on the outside of the hypogynous disk.

4. **S. rubra**, Benth. A span to a foot or more high, rather stout, more or less pubescent, and the spike tomentose, 2 to 5 inches long: radical leaves ovate or obscurely cordate, 1 to 3 inches long; the cauline similar, but small and sessile: sepals oblong. — From Montana and N. Utah westward into Oregon and Washington.

10. VERONICA, L. SPEEDWELL. BROOKLINE.

Leaves opposite or verticillate or the upper alternate, as are the bracts: flowers small, racemose, spicate, or solitary in the axils, never yellow.

* Perennials, stoloniferous or creeping at base: racemes in the axils of the opposite leaves.

← Capsules turgid, orbicular: seeds merely compressed: racemes commonly from opposite axils: corolla pale blue, often purple-striped.

1. **V. Anagallis**, L. Glabrous, or inflorescence glandular-puberulent: leaves sessile by broadish somewhat clasping base, and tapering gradually to the apex, oblong-lanceolate, entire or obscurely serrate. — Across the continent, mainly to the northward.

2. **V. Americana**, Schwein. Glabrous: leaves all or mostly petioled, ovate or oblong, truncate-subcordate at base, usually obtuse: pedicels more slender. — About the same range as the last.

← ← Capsules strongly compressed contrary to the partition: seeds very flat: racemes from alternate or sometimes from opposite axils: corolla mostly pale blue.

3. **V. scutellata**, L. Glabrous: stem slender, a span or two high: leaves sessile, linear or linear-lanceolate, acute, remotely denticulate: racemes several, filiform, flexuous: flowers scattered or filiform and widely spreading pedicels: capsule deeply emarginate at apex and slightly at base. — Across the northern part of the continent.

* * Low perennials, with ascending or erect flowering stems terminated by a single raceme: cauline leaves above passing into bracts.

4. **V. alpina**, L. A span or rarely a foot high, hirsute-pubescent or glabrate: leaves sessile, ovate to oblong, crenulate-serrate or entire, $\frac{1}{2}$ to 1 inch long: raceme spiciform or subcapitate, dense, or interrupted below: corolla blue or violet: capsule elliptical-obovate, emarginate. — Alpine regions of the Rocky Mountains, Sierra Nevada, and White Mountains, and also far northward.

5. **V. serpyllifolia**, L. Glabrous or puberulent: stems creeping or branching at base, with flowering summit ascending 3 to 9 inches high: leaves oval or roundish, entire or crenulate, half-inch or less long; the lower short-petioled; the upper sessile and passing into bracts of the leafy spiciform raceme: corolla

usually bluish or pale with blue stripes: capsule oblately orbicular and obcordate. — Throughout the continent.

* * * *Low annuals: flowers in the axils of ordinary or bract-like commonly alternate leaves, very short-pedicelled.*

6. **V. peregrina**, L. Glabrous, or above minutely pubescent or glandular: stem and branches erect, a span or two high: leaves thickish; lowest petioled and oblong or oval, dentate; the others sessile, from oblong to linear-spatulate; uppermost more bractlike and entire: capsule orbicular and slightly obcordate. — Throughout the continent. "Neckweed."

11. GERARDIA, L.

Erect and branching herbs; with mainly opposite leaves, the uppermost reduced to bracts of the racemose or paniculate showy flowers. Our species belong to the section with purple or rose-colored flowers and linear or filiform cauline leaves, the herbage blackening in drying.

1. **G. aspera**, Dougl. *Stems and branches strict: leaves rather erect, strongly hispidulous-scabrous, all filiform-linear: pedicels mostly equalling and sometimes moderately exceeding the calyx, erect: calyx-lobes deltoid-subulate or triangular-lanceolate from a broad base, about half the length of the tube: anthers obscurely if at all mucronulate at base.* — On the plains within the eastern limit of our range, and extending eastward to Wisconsin and Illinois.

2. **G. tenuifolia**, Vahl. *Smooth or usually so, about a foot high, paniculately much branched, but the inflorescence racemose: leaves mostly narrowly linear, equalling the lower but mostly shorter than the uppermost pedicels: calyx-teeth very short: corolla about a half-inch long: anthers woolly, and cuspidate-mucronate at base.*

Var. **macrophylla**, Benth. *Stouter: larger leaves $1\frac{1}{2}$ to 2 inches long and almost 2 lines wide, scabrous: pedicels ascending: calyx-teeth usually larger: corolla little over a half-inch long.* — From Colorado to W. Iowa and W. Louisiana.

12. CASTILLEIA, Mutis. PAINTED-CUP.

Herbs with alternate entire or lacinate leaves, passing above into usually more incised and mostly colored conspicuous bracts of a terminal spike: the flowers solitary in their axils, red, purple, yellowish, or whitish; but the corolla almost always duller-colored than the calyx or bracts.

* *Annuals with virgate stems, mostly tall and slender: leaves and bracts all linear-lanceolate and entire; the latter or at least the upper with red linear tips.*

1. **C. minor**, Gray. A foot or two high, pubescence villous or soft hirsute: flowers all pedicellate, the lower rather remote in the leafy spike: calyx gibbous and broadest at base, wholly green, about equally cleft before and behind to near the middle: corolla narrow and straight, $\frac{1}{2}$ to $\frac{3}{4}$ inch long, yellow; galea (upper lip) very much longer than the small lip, much shorter than the tube. — Bot. Calif. i. 573. *C. affinis*, var. *minor*, Gray. In wet ground, from Nebraska to W. Nevada and New Mexico.

* * *Perennials.*

+ *Calyx deeper cleft before than behind, mostly colored red, as are a part of the bracts: corolla large, an inch or two long; its galea about equalling the tube.*

2. **C. linariæfolia**, Benth. Mostly tall and strict, 2 to 5 feet high, glabrous below, the spike somewhat pubescent or villous: leaves linear, entire, or some of the upper sparingly laciniate, and the uppermost and bracts 3-parted: calyx over an inch long, mostly red or crimson, sometimes pale; the anterior fissure very much deeper than the posterior; the long upper lip acutely 4-toothed: corolla $1\frac{1}{2}$ or 2 inches long; its narrow falcate galea much exserted. — In the mountains of Wyoming and Colorado, and southward and westward.

+ + *Calyx about equally cleft before and behind: floral leaves or bracts more or less dilated and petaloid-colored (red or crimson, varying to yellowish or whitish).*

+ + *Pubescence never tomentose nor cinereous-tomentulose.*

= *Galea equalling or longer than the tube of the corolla; the lip very short.*

3. **C. parviflora**, Bong. A span to 2 feet high, villous-hirsute, at least above: leaves variously laciniately cleft into linear or lanceolate lobes, or sometimes the cauline mainly entire and narrow: calyx-lobes oblong and 2-cleft at apex or to below the middle: corolla an inch or less long: only the upper part of the narrow galea exserted; the small lip not protuberant. — From the Dakotas and Colorado westward and northward.

4. **C. miniata**, Dougl. A foot or two high, mostly simple and strict, glabrous or nearly so except the inflorescence: leaves lanceolate or linear, or the upper ovate-lanceolate, entire: spike dense and short: bracts mostly bright red, rarely whitish, seldom lobed: calyx-lobes lanceolate, acutely 2-cleft: corolla over an inch long; the galea exserted, linear, longer than the tube; very short lip protuberant and callous. — *C. pallida*, var. *miniata*, Gray. Extending southward from Alaska and British Columbia along the higher mountains of Colorado, Utah, and California. Exceedingly variable.

= = *Galea decidedly shorter than the tube of the corolla and not over twice or thrice the length of the lip.*

5. **C. pallida**, Kunth. A foot or so high, strict, commonly villous with weak cobwebby hairs, at least the dense and short leafy-bracted spike, or below glabrous: leaves mainly entire; the lower linear; upper lanceolate or ovate-lanceolate: bracts oval or obovate, partly white or yellowish, equaling the corolla: calyx cleft to or below the middle and again more or less 2-cleft: galea 2 to 4 lines long, barely twice the length of the lip, its base not exserted from the calyx.

Var. **septentrionalis**, Gray. A span to 2 feet high, sometimes almost glabrous: bracts greenish white, varying to yellowish, purple, or red: lip smaller, from half to hardly a third the length of the galea. — Bot. Calif. i. 575. Mountains of Colorado and Utah, also in the White and Green Mountains, and far northward.

Var. **occidentalis**, Gray. Dwarf and narrow-leaved form, 2 to 6 inches high: bracts comparatively broad, mostly incised or cleft, the tips and flowers whitish: lip about half the length of the rather broad galea. — Bot. Calif.

loc. cit. High alpine region of the Colorado mountains, also in the Sierra Nevada.

Var. **Haydeni**, Gray. More slender, 3 to 5 inches high: linear leaves sometimes with one or two slender-subulate lobes: bracts merely ciliate-pubescent, laciniately 3 to 5-cleft into linear lobes, bright crimson: lip not half the length of the galea. — Synopt. Fl. ii. 297. Alpine region of the Sierra Blanca, S. Colorado.

++ ++ *Tomentulose or cinereous-puberulent, or the stem only lanate-tomentose: bracts, etc. conspicuously petaloid: corolla more exserted, an inch long or over; galea shorter than the tube.*

6. **C. integra**, Gray. A span to a foot high: stem rather stout, tomentose: leaves cinereous-tomentulose, linear, $1\frac{1}{2}$ to 3 inches long, 1 to 3 lines wide, entire: bracts of the short spike red or rose-color, entire or sometimes incised: corolla $1\frac{1}{4}$ inches long; galea rather broad; lip strongly tri-callous, its lobes very short. — Bot. Mex. Bound. 119. In dry ground, from Colorado to Arizona and Texas.

+ + + *Calyx deeper cleft before than behind: corolla either slender or small, with galea much shorter than its tube and lip comparatively long: bracts and calyx if colored at all yellowish: leaves or their divisions narrowly linear, rather rigid.*

++ *Lip of corolla half the length of the short galea, more or less trisacculate and little if at all callous below the narrow lobes: flowers yellowish or greenish white: clefts of the calyx moderately unequal: leaves mostly 3 to 5-cleft and the divisions sometimes again 2 to 3-cleft: bracts similar, not even their tips colored.*

7. **C. sessiliflora**, Pursh. A span or two high, very leafy, cinereous-pubescent: leaves 2 or more inches long, with slender lobes, rarely entire: lobes of the tubular calyx slender: corolla exserted, about 2 inches long: lip with linear-lanceolate lobes very much longer than the obscurely saccate base. — On the prairies from Wisconsin and Illinois to the Dakotas, W. Texas, and New Mexico.

8. **C. breviflora**, Gray. Barely a span high, more pubescent: lower leaves often entire and upper only 3 to 5-parted, an inch or so long: bracts of the dense spike more dilated: lobes of the ovoid-oblong calyx lanceolate: corolla little exserted, less than an inch long; lip with somewhat callous or succate keels about the length of the oblong obtuse lobes. — Am. Jour. Sci. II. xxxiii. 338.

++ ++ *Lip of corolla very short, globular-saccate and callous, and with very short ovate lobes.*

9. **C. flava**, Watson. A foot high, with numerous slender stems, cinereous-puberulent, at least above, and the elongated spike more pubescent: leaves entire or the upper with one or two lobes: bracts 3-cleft and with dilated base; the upper and calyx yellowish: corolla hardly an inch long; narrow galea little shorter than the tube. — Bot. King Exped. 230. Mountains of Wyoming and E. Utah.

13. ORTHOCARPUS, Nutt.

Low herbs, with mainly alternate entire or 3 to 5-parted and lacinate leaves; the upper passing into bracts of the dense spike and not rarely colored, as also

the calyx-lobes: the corolla yellow, or white with purple or rose-color, often much surpassing the calyx.

* *Corolla with lip rather obscurely saccate, and with conspicuous mostly erect lobes; the galea broadish, obtuse.*

1. **O. pallescens**, Gray. Cinereous-puberulent, not hairy: leaves 3 to 5-parted into linear lobes, or the lower entire: bracts similar with dilated base, or the upper with shorter obscurely whitish or yellowish lobes: calyx deeply 2 cleft, with broad lobes merely 2-cleft at apex: corolla yellowish, over a half-inch long. — *Am. Jour. Sci.* 11. xxxiv. 339. From the mountains of N. W. Wyoming to E. Oregon.

* * *Corolla with simply saccate lip inconspicuously or obsoletely 3-toothed, and moderately smaller ovate-triangular galea; its small tip or mucro usually somewhat inflexed or uncinat.*

+ — *Bracts strikingly different from the leaves, much dilated, entire or the lower 3 to 5-lobed, the summit of the middle lobe purple: corolla yellow.*

2. **O. linearifolius**, Benth. Strict, branching at summit, sparsely hirsute or hispid, especially the margins of the 3 to 5-lobed bracts: calyx half the length of the corolla, its lobes with a pair of elongated subulate teeth: corolla $\frac{3}{4}$ inch long, narrow; galea with small uncinat tip a little surpassing the lip. — *O. tenuifolius* of the *Synopt. Fl.*, in part. From the mountains of Montana to Oregon.

+ + *Bracts herbaceous, not colored, less or little different from the leaves, all 3- (rarely 5-) cleft.*

3. **O. luteus**, Nutt. Pubescent and hirsute, sometimes viscid: stem strict, a span to a foot high: leaves from linear to lanceolate, occasionally 3-cleft, about equalling the flowers: corolla golden yellow, less than a half-inch long, 2 or 3 times the length of the calyx; tip of galea obtuse and straight. — Plains, from N. Minnesota to Colorado and westward.

4 **O. Tolmiei**, Hook. & Arn. Puberulent, a span or two high, loosely branched: leaves narrowly lanceolate-linear, chiefly entire: bracts of the small and short spikes little dilated, often 3-cleft, the upper shorter than the flowers: corolla bright yellow, half-inch long, 3 or 4 times longer than the calyx: minute tip of galea inflexed. — In the Wasatch Mountains of Utah and northward.

14. CORDYLANTHUS, Nutt.

Branching annuals, with alternate and narrow leaves, either entire or 3 to 5 parted, and mostly dull-colored flowers in small terminal heads or clusters, or more scattered along the branches: the bracts and calyx not colored.

* *Calyx diphyllous: corolla 2-lipped at summit: flowers short-peduncled or sessile.*

1. **C. ramosus**, Nutt. A span or two high, diffusely much branched, cinereous-puberulent: leaves filiform, all but the lower usually 3 to 7-parted: flowers few in the small terminal heads or upper axils: corolla dull yellow, barely a half-inch long. — Dry regions from Wyoming to W. Nevada and Oregon.

* *Calyx monophyllous; the anterior division wanting: flowers strictly sessile in the axil of a clasping bract or leaf.*

2. **C. Kingii**, Watson. A foot or less high, diffusely branched, viscid-pubescent or villous: leaves 1 or 2 inches long, mostly 3 to 5-parted into linear-filiform divisions: flowers loosely glomerate or somewhat scattered at the summit of the slender branchlets: corolla less than an inch long, purplish. — Bot. King Exped. 233. S. W. Colorado to Utah and Nevada.

15. PEDICULARIS, Tourn. LOUSEWORT.

Leaves commonly pinnately cleft or dissected, mainly alternate: flowers in a terminal bracteate spike, rarely in a raceme or scattered.

* *Galea produced into a filiform porrect or soon upturned beak; throat with a tooth on each side; tube of corolla nearly included in the 5-toothed calyx: leaves lanceolate in outline, pinnately parted; the divisions acutely serrate or pinnatifid: spike dense and many-flowered, naked: corolla dull rose-red or crimson-purple.*

1. **P. Grœnlandica**, Retz. Glabrous: spike 1 to 6 inches long: calyx-teeth short: beak of the galea half-inch or more long, twice the length of the rest of the corolla, decurved on the accumbent lower lip. — Wet ground, from New Mexico to British Columbia and Hudson Bay.

* * *Galea of the short white corolla produced into a slender elongated-subulate circinate-incurved beak, nearly reaching the apex of the broad lower lip: calyx cleft in front: whole plant glabrous.*

2. **P. racemosa**, Dougl. A foot or so high, simple or sometimes branching, leafy to the top: leaves lanceolate, undivided, minutely and doubly crenulate, 2 to 4 inches long: flowers short-pedicelled, in a short leafy raceme or spike, or the lower in remote axils and uppermost with bracts hardly surpassing the 2-toothed calyx: slender beak of the galea hamate-deflexed. — From Colorado and Utah to California and British Columbia.

* * * *Galea falcate, and with a conical or thick-subulate beak, edentulate: leaves simply pinnatifid: flowers half-inch long.*

3. **P. Parryi**, Gray. Glabrous, or the inflorescence slightly pubescent: stem a span or two high, very leafy at base: leaves linear-lanceolate in outline, deeply pinnately parted; the divisions linear-lanceolate, closely callous-serrate; uppermost reduced to linear bracts: spike dense, 1½ to 4 inches long: corolla ochroleucous or more yellow; galea strongly falcate, with decurved beak, of about the length of the width of the galea. — Am. Jour. Sci. II. xxxiii. 250. In the mountains from Colorado and Utah to Wyoming and Montana.

* * * * *Galea falcate, arcuate, or with the apex more or less incurved, or anteriorly curvilinear; the beak very short and thick or commonly none: stems simple, leafy.*

+ *Not alpine: leaves pinnatifid: spike short and dense: cucullate summit of the galea incurved.*

4. **P. Canadensis**, L. Hirsute-pubescent and glabrate, a span to a foot high: leaves oblong-lanceolate, rather deeply pinnatifid; lobes short-oblong, obtuse, incisely and the larger doubly dentate: spike leafy bracteate: corolla

ochroleucous or tinged or variegated with purple, less than an inch long: tip of galea emarginate-truncate and below conspicuously cuspidate-bidentate. — From the Colorado mountains to Canada and Florida.

+ + Not alpine, tall or slender.

+ + Leaves undivided: galea bidentulate at tip.

5. **P. crenulata**, Benth. Villous-pubescent, at length glabrate: stems a foot or less high: leaves oblong-linear or narrower, obtuse, $1\frac{1}{2}$ to 3 inches long, closely crenate and the broad crenatures minutely crenulate: spike short and dense: corolla whitish or purplish, $\frac{3}{4}$ inch long, like that of the last, but the teeth at the apex of galea less conspicuous. — In the Colorado Mountains.

+ + Leaves all pinnately parted and the lower divided, ample: divisions lacinate-serrate or pinnatifid: spike naked: galea almost straight, cucullate at summit.

6. **P. bracteosa**, Benth. Glabrous, or the dense cylindraceous and usually pedunculate spike somewhat pilose: stem 1 to 3 feet high: bracts ovate, acuminate, shorter than the flowers: calyx-lobes equalling the tube: corolla less than an inch long, pale yellow; galea much longer and larger than the lip. — From the mountains of Colorado and Utah to British Columbia.

7. **P. procera**, Gray. Puberulent: stem robust, $1\frac{1}{2}$ to 4 feet high: leaves pinnately divided into lanceolate and irregularly pinnatifid segments: bracts lanceolate, caudate-acuminate, mostly longer than the flowers, serrate or denticulate, or the upper entire: spike 8 to 15 inches long: calyx-lobes much shorter than the tube: corolla about $1\frac{1}{2}$ inches long, sordid yellowish and greenish-striate: galea hardly longer than the ample lip. — Am. Jour. Sci. II. xxxiv. 251. Mountains of Colorado and New Mexico.

+ + + Alpine: stem few-leaved, a span or so high.

8. **P. scopulorum**, Gray. Glabrous, except the arachnoid-lanate dense oblong spike: calyx-teeth triangular subulate, entire, very much shorter than the tube: galea of the reddish-purple ($\frac{3}{4}$ inch long) corolla with its somewhat produced apex obliquely truncate, edentulate or produced on each side into an obscure triangular tooth. — Synopt. Fl. II. 308. *P. Sudetica*, var. Colorado Rocky Mountains, at 12,000 to 14,000 feet.

16. RHINANTHUS, L. YELLOW-RATTLE.

Herbs, with erect stem, opposite leaves, and mostly yellow subsessile flowers in the axils, the upper ones crowded and secund in a leafy-bracted spike. Seeds when ripe rattle in the inflated dry calyx.

1. **R. Crista-galli**, L. About a foot high, glabrous, or slightly pubescent above: leaves from narrowly oblong to lanceolate, coarsely serrate; bracts more incised and the acuminate teeth setaceous-tipped: corolla barely half-inch long, only the tip exerted; transverse appendages of the galea transversely ovate, as broad or broader than long: seeds conspicuously winged. — Alpine region of the Rocky Mountains southward to New Mexico and far northward.

ORDER 57. **OROBANCHACEÆ.** (BROOM-RAPE FAMILY.)

Root-parasitic herbs, destitute of green foliage, with alternate scales in place of leaves. Flowers hermaphrodite, 5-merous as to perianth, with didynamous stamens, solitary in the axils of bracts or scales, sometimes on scapiform peduncles, sometimes collected in a terminal spike.

1. **APHYLLON**, Mitchell. **CANCER-ROOT.**

Flowers pedunculate or pedicellate: calyx 5-cleft: corolla somewhat bilabiate; upper lip more or less spreading, mostly 2-lobed; lower spreading: stamens included: style deciduous.—Brownish or whitish, low, commonly viscid-pubescent or glandular plants; with violet-purplish or yellowish flowers.

* *Peduncles or scapes long and slender from the axils of fleshy loose scales, not bracteolate: corolla with elongated somewhat curved tube, and widely spreading somewhat equally 5-lobed limb, only obscurely bilabiate.*

1. **A. uniflorum**, Gray. Scaly stem short and nearly subterranean, bearing few scapes a span high: *calyx-lobes mostly much longer than the tube, subulate*, usually attenuate: *corolla violet-tinged*, the flower an inch long; *the lobes obovate and rather large*.—Damp woods; from Newfoundland to Texas, and westward across the continent.

2. **A. fasciculatum**, Gray. More pubescent and glandular: stem often emergent and mostly as long as the numerous *fusculated peduncles*, not rarely shorter: *calyx-lobes broadly or triangular-subulate, not longer than the tube*, very much shorter than the dull yellow or purplish corolla; *lobes of the latter oblong and smaller*.—From Lake Michigan to Arizona and westward across the continent; on *Artemisia*, *Eriogonum*, etc.

Var. **luteum**, Gray. A very caulescent and short-peduncled form, with sulphur-yellow corolla, and whole plant light yellow.—Synopt. Fl. ii. 312. Wyoming, *Parry*. On grasses.

* * *Caulescent, and the inflorescence thyrsoid or spicate: pedicels or calyx 1 to 2-bracteolate: corolla manifestly bilabiate.*

3. **A. multiflorum**, Gray. Whole plant viscidly pruinose-puberulent, a span or two high: flowers nearly sessile or the lower ones short-pedicelled: *calyx* bibracteolate, *almost 5-parted* into linear-lanceolate lobes, fully half the length of the ample (*inch or more long*) purplish corolla: *anthers very woolly*.—Gravelly plains and pine woods, W. Texas to Arizona, extending into S. Colorado.

4. **A. Ludovicianum**, Gray. Rather less pubescent: spikes more frequently compound: *calyx less deeply and somewhat unequally 5-cleft: corolla about half smaller*; upper lip sometimes almost entire: *anthers* (before dehiscence) *glabrous or nearly so*.—*Phelipaea Ludoviciana*, Walp. From the Saskatchewan to Texas and westward.

ORDER 58. **LENTIBULARIACEÆ.** (BLADDERWORT FAMILY.)

Herbs, growing in water or wet soil, with scapes or scapiform peduncles simple and one to few-flowered, calcarate corolla always and calyx usually bilabiate, a single pair of stamens, confluent one-celled anthers contiguous under the broad stigma.

1. UTRICULARIA, L. BLADDERWORT.

Calyx 2-parted or deeply 2-lobed; lobes mostly entire, nearly equal: upper lip of strongly bilabiate and more or less personate corolla erect: filaments thick, strongly arcuate-incurved, the base and apex contiguous. — Ours are aquatic, with the dissected leaves, branches, and even roots, bearing little bladders, which are furnished with a valvular lid, and commonly tipped with a few bristles at orifice, and yellow flowers. The scapes are leafless, emerged from submersed or floating leafy stems, which are free swimming and mostly rootless in deep water.

* *Pedicels recurved in fruit.*

1. **U. vulgaris, L.** Stems long and rather stout, densely leafy: leaves 2 to 3-pinnately divided, very bladdery: scapes a foot or less long, 5 to 16-flowered: corolla half-inch or more broad, with sides of lips reflexed; palate prominent: spur conical, porrect toward the slightly 3-lobed lower lip. — From Newfoundland to the Saskatchewan and Texas, and westward across the continent.

2. **U. minor, L.** Leaves scattered on the filiform stems, repeatedly dichotomous, small, setaceous: scapes slender, 3 to 7 inches high, 2 to 8-flowered: corolla pale yellow, 2 or 3 lines broad, ringent; palate depressed: spur very short and obtuse. — Across the continent.

* * *Pedicels erect in fruit.*

3. **U. gibba, L.** Branches delicate, root-like: leaves sparse, sparingly dissected, capillary, sparingly bladder-bearing: scape filiform, 1½ to 3 inches high, 1 to 2-flowered: corolla 3 lines broad; the lips broad and rounded: spur thick and conical, shorter than the lower lip and approximate to it. — In a subalpine pond in Colorado, *Greene*. Also in the Atlantic States.

ORDER 59. **VERBENACEÆ.** (VERVAIN FAMILY.)

Herbs or shrubs, with chiefly opposite or verticillate leaves, no stipules, bilabiate or almost regular corolla, mostly didynamous stamens, single style with one or two stigmae, an undivided 2 to 4-celled ovary. — In ours the inflorescence is simple, commonly spicate or capitate with flowers alternate, and the leaves are simple.

1. **Verbena.** Calyx narrow, tubular, plicately 5-angled, 5-toothed. Corolla salverform; the limb somewhat equally or unequally 5-lobed. Fruit separating into 4 nutlets.
2. **Lippia.** Calyx ovoid, oblong-campanulate or compressed and bicarinate, 2 to 4-cleft or toothed. Limb of corolla oblique or bilabiate, 4-lobed. Fruit separating into 2 nutlets.

1. VERBENA, Tourn. Vervain.

Some mere weeds, others ornamental, and many spontaneous hybrids.

* *Flowers small or comparatively so, in narrow spikes: anthers unappendaged.*

+ *Bracts inconspicuous, not exceeding the flowers.*

1. **V. hastata**, L. Tall, 3 to 6 feet high: *pubescence short, sparse and hirsute or scabrous: leaves oblong-lanceolate, gradually acuminate, coarsely or incisely serrate, petioled, some of the lower commonly hastate 3-lobed at base: spikes numerous in a panicle, dense, naked at base or more or less peduncled: corolla blue.* — In waste grounds and along roadsides, across the continent.

2. **V. stricta**, Vent. Erect, rather stout, a foot or two high: *pubescence softer and denser: leaves cinereous with dense soft hirsute-villous pubescence, thickish, rugose-veiny, ovate or oblong, nearly sessile, very sharply and densely mostly doubly serrate, rarely incised: spikes comparatively thick, dense both in flower and fruit, canescent, mostly sessile or leafy-bracted at base: corolla blue, 4 or 5 lines long.* — From New Mexico to the Dakotas and eastward to Texas and Ohio.

+ + *Bracts rigid and somewhat foliaceous, exceeding the flowers.*

3. **V. bracteosa**, Michx. Much branched from the base, diffuse or decumbent, hirsute: *leaves cuneate-oblong or cuneate obovate, narrowed mostly into a short margined petiole, pinnately incised or 3-cleft, and coarsely dentate: spikes terminating the branches: lowest bracts often pinnatifid or incised; the others lanceolate, acuminate, entire, rigid: corolla purplish or blue, very small.* — Across the continent.

* * *Flowers more showy, at first depressed-capitate, becoming spicate in fruit: anthers of the larger stamens appendaged by a gland on the connective: tube of corolla at the upper part lined with reflexed bristly hairs.*

4. **V. bipinnatifida**, Nutt. A span to a foot high, *hispid-hirsute, rooting from subterranean branches: leaves $1\frac{1}{2}$ to 4 inches long, bipinnately parted, or 3-parted into more or less bipinnatifid divisions: bracts setaceous-attenuate, mostly surpassing the calyx: limb of the bluish-purple or lilac corolla 4 or 5 lines broad; lobes obcordate: commissure of the nutlets usually retrorsely scabrous or hispidulous.* — Plains and prairies, from Arkansas and Texas to the mountains of Colorado.

5. **V. Aubletia**, L. A foot or less high, branching and ascending from a creeping or rooting base, *soft-pubescent, hirsute, or glabrate: leaves 1 or 2 inches long, ovate or ovate-oblong in outline, with truncate or broadly cuneate base tapering into a margined petiole, incisely lobed and toothed, often more deeply 3-cleft: bracts subulate or linear-attenuate, shorter than or equalling the calyx: limb of the reddish-purple or lilac (or white) corolla $\frac{1}{2}$ or $\frac{2}{3}$ inch broad: commissure of the nutlets minutely white-dotted or nearly smooth.* — From the Rocky Mountains eastward across the continent.

2. LIPPIA, L.

In ours the flowers are capitate or in short dense spikes, subtended and imbricated by broad bracts; the peduncles chiefly axillary.

1. **L. cuneifolia**, Steud. Diffusely branched, *procumbent (not creeping)*, minutely canescent throughout: *leaves rigid*, cuneate-linear, *sessile*, *incisely 2 to 6-toothed above the middle*: *peduncles mostly shorter than the leaves*: bracts rigid, broadly cuneate, abruptly acuminate from the truncate or retuse dilated summit: calyx-lobes emarginate: corolla white (?).—On the plains from Nebraska to New Mexico and Arizona.

2. **L. lanceolata**, Michx. *Creeping extensively*, some branches ascending, minutely and sparsely strigulose: *leaves thinner*, varying from obovate and lanceolate-spatulate to ovate, *narrowed at base mostly into a petiole*, *above sharply serrate*: *peduncles much exceeding the leaves*: bracts mucronate or pointless: calyx-lobes linear-lanceolate: corolla bluish-white.—From E. Colorado and Texas to Pennsylvania and Florida.

ORDER 60. LABIATÆ. (MINT FAMILY.)

Chiefly herbs, with aromatic foliage, square stems, opposite leaves, more or less bilabiate corolla, didynamous or diandrous stamens, and a deeply 4-lobed ovary, which forms in fruit 4 seed-like nutlets, surrounding the base of the single style.—Upper lip of the corolla 2-lobed or entire: the lower 3-lobed. Stamens inserted on the tube of the corolla. Style 2-lobed at apex. Flowers axillary, chiefly in cymose clusters, these often aggregated in terminal spikes or racemes.

Tribe I. Stamens 4, ascending, mostly exserted from the upper side of the corolla: calyx 5 to 10-nerved. — **AJUGOIDEÆ.**

1. **Teucrium**. Corolla deeply cleft between the two small lobes of the upper lip, which are united one on each side with the lateral lobes of the declined lower lip: middle lobe much larger. Stamens exserted from the cleft: anthers confluent one-celled.

Tribe II. Stamens not declined; the posterior pair shorter or wanting; anthers 2-celled; the cells distinct or confluent, short: corolla less strongly bilabiate and the lobes flatter than in succeeding tribes; upper lip not galeate or concave.

* Corolla about equally 4-lobed, small and short, hardly irregular, but the upper lobe broader than the others and emarginate: stamens erect, straight and distant: flowers capitate-glomerate, and the clusters sometimes confluent-spiked.

2. **Mentha**. Stamens 4, similar and nearly equal. Calyx 5-toothed. Upper lobe of corolla sometimes emarginate.

3. **Lycopus**. Stamens only 2 with anthers; the upper pair sterile rudiments, or else wanting. Calyx 4 to 5-toothed, naked in the throat. Upper lobe of corolla entire.

** Corolla more or less evidently bilabiate; the upper lip erect, entire or emarginate, or 2-cleft in No. 5; the lower spreading and 3-cleft.

+ Stamens 4, didynamous, distant and straight, often divergent, never convergent nor curved: calyx 10 to 15-nerved: flowers capitate-verticillistrate, or sometimes sparser.

4. **Pycnanthemum**. Calyx ovate-oblong or tubular; the 5 teeth equal, or the 3 upper more or less united. Corolla with entire or barely emarginate upper lip, and 3-cleft lower one. Stamens little unequal: anther-cells parallel.

5. **Monardella**. Calyx tubular, narrow; the 5 teeth equal or nearly so. Corolla with 2-cleft upper lip, and 3-parted lower one. Stamens strongly or moderately unequal, exserted: anther-cells often divergent or divaricate. Flowers densely capitate-verticillistrate.

+ + Stamens ascending or arcuate, often more or less converging and sometimes ascending parallel under the erect upper lip of the corolla; anther-cells oblique or divaricate: calyx 12 to 15-nerved.

6. **Calamintha.** Calyx oblong or tubular, often gibbous, bilabiate; the upper lip 3-toothed or 3-cleft, the lower 2-parted. Corolla with a straight tube mostly exceeding the calyx, and a commonly enlarging throat. Stamens 4, ascending parallel under or beyond the upper lip, or conniving in pairs.

7. **Hedeoma.** Calyx from tubular to oblong, usually gibbous, more or less bilabiate or unequally 5-toothed, mostly 13-striate, hairy or villous-bearded in the throat. Antheriferous stamens 2, ascending parallel under the upper lip; the posterior pair either none or sterile.

Tribe III. Antheriferous stamens only 2, straight or commonly parallel-ascending; the anther with narrow cells, which are either widely separated on the upper and lower ends of a linear or filiform connective, or the lower cell wanting or deformed, or the two cells confluent into one linear cell: corolla bilabiate. — **MONARDEÆ.**

8. **Salvia.** Calyx bilabiate. Corolla with upper lip erect, straight or falcate, usually concave; the lower spreading, its middle lobe often emarginate. Connective commonly linear or filiform, transverse and articulated on the short filament.

9. **Monarda.** Calyx elongated-tubular, mostly 15-nerved, regular or nearly so, almost equally 5-toothed. Corolla with slender tube or dilated at the throat; the upper lip erect, entire or emarginate; the lower spreading, 3-lobed, its middle lobe larger or longer, refuse or emarginate. Anther-cells contiguous and divaricate, more or less connate or confluent at their junction, so as to imitate a single linear cell.

Tribe IV. Stamens 4, both pairs fertile; the posterior (inner or upper) pair surpassing the anterior: corolla distinctly bilabiate: calyx usually 15-nerved; the upper teeth or lip commonly larger or longer. — **NEPETEÆ.**

10. **Lophanthus.** Stamens divergent or distant, exserted; the upper pair usually declined; the lower or shorter pair ascending: the anther-cells parallel or nearly so. Corolla with tube not exceeding the oblique, 5-toothed calyx; upper lip nearly erect, 2-lobed at the apex; lower spreading, its broad middle lobe crenate.

11. **Dracocephalum.** Anthers more or less approximate in pairs; their cells divaricate or divergent; filaments not exserted. Calyx equal at throat, 5-toothed; the upper tooth very much larger than the others. Corolla with dilated throat; upper lip somewhat concave, emarginate or 2-lobed; lower spreading, with middle lobe large.

Tribe V. Stamens 4, ascending and parallel; the anterior (lower or outer) pair longer and with anthers mostly 1-celled by abortion; those of the posterior pair 2-celled: corolla bilabiate; but with the small lateral lobes more connected with the galeate upper lip; lower lip therefore of a single lobe: calyx bilabiate; its lips entire. — **SCUTELLARINÆ.**

12. **Scutellaria.** Calyx gibbous, with a crest-like or hump-shaped projection on the back, closed after the corolla falls, not inflated. Corolla with long exserted tube. Anthers ciliate-pilose.

Tribe VI. Stamens 4; parallel and ascending under the concave and commonly galeate upper lip of the bilabiate corolla; the anterior (lower or outer) pair longer: anthers 2-celled or confluent somewhat 1-celled. Calyx 5 to 10-nerved, veiny. — **STACHYDEÆ.**

13. **Physostegia.** Calyx nearly regular, and equally 5-toothed; the tube campanulate or oblong, hardly nerved or veined, moderately inflated in fruit. Corolla gradually inflated upward; upper lip erect, rounded, entire; lower somewhat spreading, 3-parted, its roundish middle lobe emarginate. Filaments villous. Flowers simply opposite in the spikes, one under each bract.

14. **Stachys.** Calyx tubular-campanulate or turbinate, 5 to 10-nerved, equally 5-toothed, sometimes the upper teeth larger. Corolla with cylindrical tube, not dilated at throat; upper lip erect, more or less concave, entire or emarginate; lower spreading, 3-lobed. Stamens more or less deflexed to the sides of the throat or contorted after anthesis: filaments naked: anthers approximate in pairs.

1. TEUCRIUM, L. GERMANDER.

Herbs: less aromatic than most genera, with leaves variously cut and flowers spicate or solitary and axillary.

* *Leaves undivided: flowers in naked terminal spikes or racemes: calyx moderately 5-lobed; two lower teeth triangular-subulate; three upper ovate.*

1. **T. occidentale**, Gray. Loosely pubescent, branched, a foot or two high: leaves 1 or 2 inches long, ovate-oblong to broadly lanceolate, sharply serrate: corolla 4 or 5 lines long, purple, rose or cream-color: calyx villous with viscid hairs. — Synopt. Fl. ii. 349. *T. Canadense* of the Western Reports. Nebraska to New Mexico and California.

* * *Leaves multifid or incised: flowers solitary and axillary, the uppermost leaves more or less bract-like: calyx almost 5-parted into subulate-lanceolate equal lobes.*

2. **T. laciniatum**, Torr. Glabrous or hirsute-pubescent, much branched, a span or so high: leaves pinnately 3 to 7-parted into narrow linear entire or 2 to 3-lobed or toothed divisions, rather rigid; the floral much crowded, 3-parted: corolla 6 to 10 lines long, pale blue or lilac, with spatulate lower lobe much surpassing the calyx. — Ann. Lyc. N. Y. ii. 231. Plains of Colorado to Arizona and W. Texas.

2. MENTHA,¹ Tourn. MINT.

Odorous herbs, mostly spreading by slender creeping rootstocks: flowers small, whitish or purplish, in ours glomerate in the axils of leaves.

1. **M. Canadensis**, L. Villous-hairy: stem often simple: leaves varying from oblong-ovate to oblong-lanceolate, sharply serrate, acute, generally tapering into the petiole: inflorescence consisting of distant sessile verticillastrate glomerules in the axils of the leaves, the uppermost axils flowerless: calyx hairy; the short teeth triangular-subulate. — Wet places, throughout the continent, chiefly towards the north. Odor of Pennyroyal.

Var. **glabrata**, Benth., has leaves and stem almost glabrous, the former sometimes very short-petioled, and a sweeter scent, as of *Monarda*. — Same range.

3. LYCOPUS, Tourn. WATER HOREHOUND. BUGLE-WEED.
GYPSY-WORT.

Mint-like, but bitter and only slightly aromatic; with sharply toothed or lobed leaves, and small white or whitish flowers in their axils, in sessile capitate-verticillastrate glomerules, the uppermost axils flowerless.

* *Stoloniferous; long filiform runners produced from the base of the stem: calyx-teeth mostly 4.*

1. **L. Virginicus**, L. Glabrous or somewhat pubescent: stem obtusely angled, 6 to 24 inches high: leaves ovate or oblong-lanceolate, coarsely serrate

¹ Doubtless some of the common introduced species have become established within our range.

in the middle, acuminate at both ends, tapering into a short petiole: bracts very short: calyx-teeth ovate or lanceolate-ovate, obtuse or barely acutish: sterile stamens minute rudiments. — From British Columbia and Oregon to Florida and Labrador.

2. **L. lucidus**, Turcz. Stem strict, stout, 2 or 3 feet high, hirsute-pubescent or glabrate, *acutely angled above: leaves lanceolate and oblong-lanceolate, 2 to 4 inches long, acute or acuminate, very sharply and coarsely serrate with triangular-subulate ascending teeth, sessile or nearly so by an obtuse or acute base, coarsely punctate: outer bracts conspicuous, very acute: calyx-teeth attenuate-subulate: sterile stamens clavate-tipped rudiments.*

Var. **Americanus**, Gray. Leaves dull, often minutely puberulent both sides: calyx-teeth less rigid. — Bot. Calif. i. 592. From the Saskatchewan to Arizona and California.

* * *Not stoloniferous, but rootstocks more or less creeping: calyx-teeth 5, cuspidate, rigid.*

3. **L. sinuatus**, Ell. Stem erect, 1 to 3 feet high, acutely 4-angled, glabrous, roughish or minutely pubescent: leaves oblong or lanceolate, $1\frac{1}{2}$ or 2 inches long, acuminate, irregularly incised or lacinate-pinnatifid, or some of the upper merely sinuate or incisely toothed, tapering at base mostly into a slender petiole: rudiments of sterile stamens slender, conspicuous, with a globular or subclavate tip. — *L. Europæus*, var. *sinuatus*, Gray. Across the continent.

4. PYCNANTHEMUM, Michx. MOUNTAIN MINT. BASIL.

Erect herbs, pleasantly aromatic, branching above; flowers small, whitish or purplish, often purple-dotted. In ours the flowers are in small and numerous glomerules which are capitate and densely fastigate-cymose, copiously imbricated with short appressed bracts.

1. **P. lanceolatum**, Pursh. Stem somewhat pubescent: inflorescence villous-canescens: leaves lanceolate or almost linear, nervose-veined, obtuse at base, nearly sessile, entire: bracts ovate or lanceolate: calyx-teeth ovate-deltoid, acute. — Within the eastern limit of our range, and extending from thence eastward across the continent.

5. MONARDELLA, Benth.

Flowers in terminal and solitary verticillastrate heads, subtended or involucrate by broad often membranaceous and colored bracts: corolla from whitish or flesh-color to rose-purple.

1. **M. odoratissima**, Benth. Cinereous-puberulent or minutely tomentulose, or nearly glabrous, but pale: a span to a foot high: leaves from narrowly oblong to broadly lanceolate, entire or nearly so, short-petioled, or the upper subsessile, both sides alike: bracts thin-membranaceous and colored (whitish or purple): calyx-teeth hirsute. — Sierra Madre Range in Colorado, and thence westward and northward. Odor of Pennyroyal.

6. CALAMINTHA, Tourn., Mœnch. CALAMINT.

Our species belongs to a section with flowers verticillastrate-capitate, and involucrate with conspicuous setaceous-subulate rigid bracts.

1. **C. Clinopodium**, Benth. Herbaceous, hirsute: leaves ovate, obtuse, almost entire, petioled: heads globular, many-flowered: teeth of the narrow tubular calyx and bracts very hirsute, nearly equalling the light purple narrow corolla. — Indigenous from the Rocky Mountains to the Great Lakes, but introduced eastward. "Basil."

7. HEDEOMA, Pers. AMERICAN PENNYROYAL.

Our species belong to the section with pedicellate flowers cymulose in the axils of the leaves, the uppermost of which are often bract-like: throat of the calyx in fruit closed with a ring of hair. Pungently sweet-aromatic, with small and whitish or purplish flowers.

1. **H. hispida**, Pursh. Mostly low: *leaves all similar, linear, entire, thickish, nearly sessile, crowded, almost glabrous*, but the margins somewhat hispid-ciliate: bracts mostly equalling the calyx, rigid: *calyx with teeth about equal, bilabiate*; the lips about half the length of the oblong gibbous hispid tube; the teeth of the upper subulate, of the lower more aristiform or hispid, *equalling the bluish corolla*. — Extending into the Dakotas and southward from the plains west of the Mississippi.

2. **H. Drummondii**, Benth. *Cinereous pubescent or puberulent*, a span or two high, copiously branched: *leaves from oblong to linear, obtuse, subsessile or narrowed into a very short petiole: subulate bracts not longer than the pedicels: calyx hirsute or hispid, in age more or less curved, not plainly bilabiate*; the subulate-setaceous teeth at length all connivent; *the lower nearly twice the length of the upper: corolla from little exerted to double the length of the calyx*. — From Texas to Arizona and extending northward to Colorado and Nebraska.

8. SALVIA, L. SAGE.

In ours the throat of the calyx is naked: the anterior portion of the connective deflexed, linear or gradually somewhat dilated downward, closely approximate or connate, and destitute of an anther-cell: corolla blue or purplish varying to white.

1. **S. azurea**, Lam. Glabrous or puberulent, 1 to 5 feet high: lower leaves lanceolate or oblong, obtuse, denticulate or serrate; upper narrower, often linear, entire: inflorescence spiciform, interrupted, sometimes thyrsoidal or paniculate-branched: *calyx obscurely bilabiate: corolla deep blue, with prominently exerted tube*; upper lip very concave or galeate and pubescent; *the lower longer and much larger, sinuately 3-lobed and emarginate. style bearded above*.

Var. **grandiflora**, Benth. Cinereous-puberulent: denser inflorescence and calyx tomentulose-sericeous. — *S. Pitcheri*, Torr. From Colorado to Texas and Kansas.

2. **S. lanceolata**, Willd. Puberulent or nearly glabrous, branched from the base, 5 to 12 inches high: leaves lanceolate or linear-oblong, obtuse, irregu-

larly serrate with obtuse appressed teeth or nearly entire: inflorescence virgate-spiciform, interrupted, floral bracts very small: *calyx deeply bilabiate: corolla small, 4 lines long, hardly at all exerted; lower lip little prolonged: style glabrous or nearly so.* — Plains, Nebraska to Texas and Arizona.

9. MONARDA, L. HORSE-MINT.

Aromatic erect herbs, usually tall; with the large verticillastrate-capitate glomerules single, or in upper axils, and involucrate by numerous sometimes colored outer bracts and floral leaves.

* *Heads solitary and terminal, or sometimes 2 or 3 as if proliferous: stamens and style conspicuously exerted from the linear and mostly acute upper lip of the corolla: leaves ovate-lanceolate, acutely more or less serrate.*

1. **M. fistulosa**, L. Soft-pubescent with short hairs, or somewhat hairy, or glabrate: stem mostly with obtuse angles: bracts whitish or rarely purplish, the inner mostly hirsute-ciliate: calyx conspicuously and densely bearded at the throat: corolla pubescent, at least on the upper lip, purple or purplish-dotted, an inch or more long. — Nearly across the continent. A polymorphous species.

Var. **media**, Gray. Corolla deep purple. — Synopt. Fl. ii. 374. Alleghany and Rocky Mountains.

Var. **mollis**, Benth. Corolla from flesh-color to lilac, glandular, and its upper lip hairy outside or more bearded at the tip: leaves paler, soft pubescent beneath: throat of the calyx mostly filled with dense beard. — Extending to the Saskatchewan, British Columbia, and Arizona.

* * *Heads commonly in the axils of all the upper pairs of leaves, or interrupted-spicate, foliose-bracteate: upper face of the floral leaves often canescent and purple-tinged: corolla with shorter tube, more dilated throat; the upper arching seldom surpassed by the stamens: leaves lanceolate or oblong, sparsely serrate or denticulate.*

2. **M. punctata**, L. Stem commonly 2 feet high: floral leaves and bracts (either whitened or purplish or both) often slender acuminate, mostly muticous: calyx-teeth lanceolate- or triangular-subulate, rigid, soon stellate-spreading: corolla yellowish with copious brown-purple spots. — From Colorado to Florida and New York.

3. **M. citriodora**, Cerv. Usually rather robust, the larger forms 2 or 3 feet high: bracts narrowly oblong, colored as in the last, with spreading or recurving and slender aristate tips: calyx-teeth slender-aristiform, at length usually spreading: corolla white or pinkish, not spotted, but more or less punctate. — *M. aristata*, Nutt. Plains of Nebraska to Texas, E. Colorado, and Arizona.

10. LOPHANTHUS, Benth.

Mostly tall and coarse herbs: with serrate petioled leaves, the lower usually subcordate and the upper ovate, and small flowers in dense and sessile verticillastrate glomerules, which are crowded into a terminal spike: floral leaves

reduced to short ovate and acuminate bracts: calyx-teeth more or less colored.

1. **L. anisatus**, Benth. Glabrous or very minutely puberulent, 2 or 3 feet high: leaves ovate, often subcordate, *canescent beneath, anisate-scented when crushed*: spike short and narrow, interrupted, sometimes leafy below and paniculate: calyx-teeth ovate-lanceolate and *merely acute*, tinged with purple or violet: *corolla blue*. — Plains, from the Saskatchewan to Nebraska and westward to the mountains.

2. **L. urticifolius**, Benth. Like the last, but leaves green both sides, mostly crenate and more or less cordate, sweet-aromatic: calyx-teeth lanceolate, *subulate-acuminate*: *corolla light violet or purplish*. — Western slopes of the mountains to Oregon and California.

11. DRACOCEPHALUM, Tourn. DRAGON-HEAD.

Herbs, peculiar for the small and included corolla.

1. **D. parviflorum**, Nutt. Rather stout, 6 to 20 inches high, somewhat pubescent: leaves lanceolate or oblong, petioled, incisely dentate, or the lower pinnatifid-incised; the lower floral similar: flowers numerous in sessile glomerules crowded in a thick terminal leafy-bracted head or short spike interrupted at base: bracts pectinate-laciniate and the teeth aristate: corolla bluish, slender, hardly exceeding the calyx. — New York to British Columbia, and southward along the mountains to New Mexico.

12. SCUTELLARIA, L. SKULLCAP.

Flowers mostly blue, solitary in the axils of the leaves, or in spikes or racemes from the reduction of the floral leaves to bracts.

* *Flowers small ($\frac{1}{4}$ inch long), in axillary and sometimes also terminal racemes.*

1. **S. lateriflora**, L. Glabrous, a foot or two high, leafy: leaves thin, oblong-ovate and ovate-lanceolate, acuminate, coarsely serrate, rounded at base, slender petioled; the lower floral ones of the terminal racemes similar: lips of the corolla short, equal in length. — From Oregon to New Mexico and eastward across the continent.

* * *Flowers solitary in the axils of the cauline leaves, or some occasionally imperfectly racemose, violet-blue.*

2. **S. resinosa**, Torr. *Barely a span high*, branched from the base, minutely pubescent and *resinous atomiferous*, somewhat viscid: leaves uniform, *oval or oblong, obtuse*, mostly sessile, 5 to 10 lines long, nervose-veined: corolla pubescent, *an inch long*, with slender tube and ampliate throat. — Plains of Nebraska, Wyoming, and Colorado.

3. **S. galericulata**, L. Nearly glabrous or slightly pubescent, slender, 1 to 3 feet high, simple or paniculately branched above: *leaves ovate-lanceolate*, broadest next the subsessile subcordate base, 2 inches or less long, all but the upper appressed-serrate: corolla puberulent, $\frac{1}{2}$ to $\frac{3}{4}$ inch long; lower lip nearly erect and surpassing the upper. — From British Columbia to Arizona and eastward across the continent.

13. **PHYSOSTEGIA**, Benth. FALSE DRAGON-HEAD.

Almost glabrous herbs: with lanceolate and callose-denticulate or serrate leaves; the upper ones sessile, lowest tapering into a petiole, floral reduced to bracts of the simple or paniced spikes. Flowers cataleptic (remaining in whatever position they may be turned). Corolla showy rose or flesh-color, often variegated.

1. **P. parviflora**, Nutt. Stems rather slender, leafy, a foot or two high: leaves lanceolate or ovate-lanceolate, denticulate: spikes short, 1 to 4 inches long: calyx short-campanulate, inflated-globular in fruit and with short mostly obtuse teeth: corolla $\frac{1}{2}$ inch long. — Saskatchewan and Wyoming to Oregon and British Columbia.

14. **STACHYS**, Tourn. WOUNDWORT.

Flowers verticillastrate-capitate or clustered, or sometimes few or solitary in the axils of the floral leaves, forming usually an interrupted spicate inflorescence. In ours the corolla is purple or rose-red, not over $\frac{1}{2}$ inch long; the tube not exceeding the calyx-teeth.

1. **S. palustris**, L. From densely soft-pubescent to roughish-hirsute, leafy: stem 1 to 3 feet high, hirsute or hispid: leaves ovate-lanceolate, crenate-serrate, $1\frac{1}{2}$ to 3 inches long, sessile or nearly so by a broad or subcordate base, sometimes almost velvety-tomentose beneath: clusters of the spike mostly approximate, 6 to 10-flowered. — Across the continent.

ORDER 61. **PLANTAGINACEÆ**. (PLANTAIN FAMILY.)

Chiefly acaulescent herbs with one to several-ribbed or nerved radical leaves, simply spicate inflorescence, and regular 4-merous flowers, and the corolla scarious and veinless.

1. **PLANTAGO**, Tourn. PLANTAIN. RIBWORT.

Flowers perfect or polygamo-dioecious, each subtended by a bract: corolla salverform with a short tube, or nearly rotate: stamens 4 or sometimes 2, on the tube of the corolla: ovary 2-celled, with one or more ovules in each cell: capsule circumscissile toward the base: scape from the axils of the radical leaves, mostly bearing a single simple spike or head of greenish or whitish small flowers.

* *Stamens 4: flowers all perfect: corolla remaining expanded, never closed over the fruit.*

+ *Leaves 3 to 8-nerved or ribbed, varying from glabrous to pubescent, from lanceolate to almost rotund.*¹

1. **P. major**, L. Leaves ovate or oval, rarely subcordate, several-ribbed: spike commonly dense, obtuse at apex: sepals rotund-ovate or obovate; the

¹ The introduced *P. lanceolata*, L., may be known by its oblong-lanceolate 3 to 5-ribbed leaves, tapering into a slender petiole, usually much shorter than the slender and angled

exterior one and the bract more or less carinate: capsule ovoid, very obtuse, circumscissile near the middle and near the level of the summit of the sepals. — Introduced to the east, but also native from Lake Superior westward and northward. "Common Plantain."

2. **P. eriopoda**, Torr. *Usually a mass of yellowish wool at the crown: leaves oblanceolate to oval-obovate, fleshy-coriaceous, 3 to 7-nerved, 3 to 5 inches long, with a short or stout petiole: spike cylindrical, dense or sometimes sparsely-flowered: sepals roundish-obovate, scarious except the midrib: capsule ovoid, slightly exceeding the calyx.* — From Colorado to California and northward to Wyoming and the Saskatchewan.

+ + *Leaves 1 to 3-nerved, silky-pubescent or lanate, from narrowly linear to oblanceolate.*

3. **P. Patagonica**, Jacq. Silky-lanate or glabrate: leaves acute or callous-pointed, tapering below into a petiole, entire or sparingly denticulate: scape terete, 3 to 12 inches high including the dense spike: flowers heterogonous, often cleistogamous: sepals very obtuse: corolla with broad cordate or ovate lobes: filaments in the long-stamened individuals capillary and much exerted: in the other forms included. — Dry plains, from the Mississippi westward across the continent. Exceedingly variable, including many forms that have been described as species. The following are the principal forms which abound west of the Mississippi:

Var. **gnaphalioides**, Gray, is the commoner form, canescently villous, the wool often floccose and deciduous: leaves from oblong-linear or spatulate-lanceolate to nearly filiform: spike very dense, 1 to 4 inches long, varying to capitate and few-flowered, lanate: bracts oblong or linear-lanceolate, or the lowest deltoid-ovate, hardly longer than the calyx.

Var. **spinulosa**, Gray, is a canescent form with aristately prolonged and rigid bracts.

Var. **nuda**, Gray, has sparse and loose pubescence, green and soon glabrate rigid leaves, and short bracts.

Var. **aristata**, Gray, is loosely villous and glabrate: leaves green: bracts attenuate-prolonged to twice or thrice the length of the flowers.

* * *Stamens 2: flowers subdiacious or diacio-cleistogamous: corolla in the fertile plant remaining closed or closing over the maturing capsule and forming a kind of beak: leaves linear or filiform.*

4. **P. pusilla**, Nutt. Somewhat cinereous-puberulent: leaves about an inch long and half a line wide: spike filiform or slender, at length sparse-flowered, $\frac{1}{2}$ to 3 inches long: capsule short-ovoid, about a line long, little exceeding the bract and calyx. — From the Atlantic States west to Nebraska; also in the Great Basin and Oregon.

scape; its spike at first capitate, in age cylindrical, dense; the bract and sepals broadly ovate, brownish. — Generally in cultivated fields. "Ripple- or Rib-grass," "English Plantain."

DIVISION III. APETALÆ.

Floral envelope consisting only of a calyx (often petaloid) or wholly wanting.

ORDER 62. NYCTAGINACEÆ. (FOUR-O'CLOCK FAMILY.)

Herbs, with mostly opposite and entire leaves, stems tumid at the joint, a delicate tubular or funnel-form calyx which is colored like a corolla, its persistent base constricted above the 1-celled, 1-seeded ovary, and indurated into a sort of nut-like pericarp; the stems few, slender and hypogynous; the embryo coiled around outside the mealy albumen.

* Involucre calyx-like, 3 to 5-cleft or -parted, 1 to 12-flowered: perianth tubular to funnel-form or campanulate.

1. **Mirabilis.** Involucre 5-lobed, not changed in fruit. Fruit not angled nor winged, and scarcely or not at all ribbed. Stamens usually 5.
2. **Oxybaphus.** Involucre 5-lobed, 1 to 5-flowered, in fruit becoming enlarged, thin and reticulated. Fruit several-ribbed or angled. Stamens usually 3.
3. **Allionia.** Involucre deeply 3-lobed, 3-flowered. Fruit with a double line of tubercles on the back, surrounded by a rigid winged margin, toothed and inflexed. Stamens usually 3.

* * Involucre of 5 or more distinct bracts, subtending a many-flowered head.

4. **Abronia.** Perianth salver-form, including the stamens and style. Fruit wing-angled.

1. MIRABILIS, L. FOUR-O'CLOCK.

Stamens as long as the perianth: filaments united at base. Stigma capitate, granulate. Fruit globose to ovate-oblong. — Perennial herbs, with opposite leaves nearly equal in the pairs: peduncles solitary in the axils or paniculate: flowers nearly sessile in the involucre.

* *Involucre usually 6-flowered: flowers large: calyx long-tubular or funnelform: stamens 4 to 5.*

1. **M. multiflora**, Gray. Stout and spreading: leaves broadly ovate to ovate-lanceolate, often somewhat cordate at base but decurrent upon the petiole: involucre glabrous, campanulate, 5-cleft: flowers pale rose-color to purple, with the tube somewhat greenish, $1\frac{1}{2}$ to 2 inches long. fruit marked towards the base by ten shallow furrows and as many intermediate dark lines. — Bot. Mex. Bound. 173. From Colorado to the Rio Grande and westward to S. California.

* * *Involucre 3-flowered: flowers rather small: calyx broad-funnelform from a short tube: stamens 3.*

2. **M. oxybaphoides**, Gray. Slender, procumbent, diffuse: leaves all deeply cordate, on rather long petioles, lowest reniform, upper ones acuminate: involucre deeply 5-cleft, very viscid-glandular as well as the peduncles in the loose panicle. — S. Colorado and southward.

2. OXYBAPHUS, Vahl.

Calyx with a very short tube and a bell-shaped (rose or purple) deciduous limb, plaited in the bud. Style filiform: stigma capitate. — Herbs, with very large and thick perennial roots, and mostly clustered small flowers. Ours all have pubescent fruit and involucre 3 to 5-flowered.

1. *O. nyctagineus*, Sweet. *Nearly smooth: stem repeatedly forked: leaves all petioled, varying from ovate or somewhat heart-shaped to lanceolate: fruit rather hirsute.* — From Illinois, Wisconsin, and the Upper Missouri to Texas and New Mexico.

Var. *Cervantesii*, Gray. *Branches and involucre viscid-pubescent or villos: leaves much thicker, cordate or subcordate at base.* — Bot. Mex. Bound. 174. S. Colorado and southward.

Var. *oblongifolius*, Gray. *Leaves ovate-lanceolate or oblong, not cordate.* — Loc. cit. Near Denver and southward.

2. *O. hirsutus*, Sweet. One foot high, *very densely pilose*, with long, spreading, articulated hairs: *leaves lanceolate, the lower short-petioled: involucre pubescent-tomentose: fruit hirsute.* — From the Saskatchewan to Colorado and W. Texas.

3. *O. angustifolius*, Sweet. One to six feet high, *glabrous except the peduncles and involucre* which are pubescent: *leaves linear*, usually elongated, glaucous: *fruit hoary-pubescent.* — From Iowa and Minnesota to S. Idaho and southward to W. Texas and Mexico.

3. ALLIONIA, L.

Perianth with an oblique 4 to 5-lobed limb. Fruit ovate, compressed, smooth and convex on the inner side. — Annual or perennial herbs, with opposite very unequal leaves, and axillary pedunculate flowers.

1. *A. incarnata*, L. Stems slender, branching, prostrate: pubescence viscid, short or floccose: leaves ovate: lobes of the involucre concave: perianth rose-colored or white. — From S. Colorado to Texas, and westward to S. California.

4. ABRONIA, Juss.

Tube of the perianth elongated, and the limb of 5 (or 4) obcordate or emarginate segments. Stamens unequal, adnate to the tube. Fruit coriaceous or indurated, 1 to 5-winged, mostly reticulately veined, enclosing a smooth cylindrical akene. — Often prostrate, and usually more or less viscid-pubescent, with thick opposite unequal leaves, and elongated axillary and terminal peduncles: flowers usually very fragrant and showy.

* *Wings (if any) coriaceous, lateral and not completely encircling the fruit.*

1. *A. fragrans*, Nutt. Stems ascending: leaves oblong or ovate, truncate or more or less cuneate at base: peduncles elongated: bracts of the involucre large, broadly ovate, white and scarious: fruit narrowly 1 to 2-winged, not crested. — From Iowa to Salt Lake Valley and southward to Arizona and New Mexico.

* * *Wings membranous, orbicular, wholly encircling the fruit, strongly net-veined.*

2. **A. micrantha**, Torr. Prostrate: peduncles shorter than the petioles: flowers small and inconspicuous, reddish green, the limb scarcely 2 lines broad: fruit orbicular with 3 thin wings, emarginate above and below, the body rather broad and with a light spongy exterior. — On the plains from the Saskatchewan to the Arkansas and S. W. Colorado. Often confounded with the next, which is of more southern range.

3. **A. cycloptera**, Gray. Stouter: flowers large and showy, upon elongated peduncles: fruit with firmer and more prominently veined wing, emarginate at neither end, the firm smooth narrow body usually 3-nerved between the wings. — S. Colorado to New Mexico and W. Texas.

ORDER 63. ILLECEBRACEÆ.

An order related to both *Caryophyllaceæ* and *Amarantaceæ*, but placed by Bentham and Hooker with the latter. Distinguished from the scarious-stipulate *Caryophyllaceæ* by the solitary or sometimes geminate ovules, undivided or 2-cleft style, and one-seeded utricular or akene-like fruit: the petals wholly wanting or reduced to mere filaments; these and the stamens usually more perigynous.

1. PARONYCHIA, Tourn. WHITFLOW-WORT.

Sepals 5, linear or oblong concave, awned at the apex. Stamens 5. — Tufted herbs, with dry and silvery stipules.

* *Flowers terminal, solitary and sessile.*

1. **P. pulvinata**, Gray. Matted-cespitose from a woody root, forming dense cushion-like tufts: stipules broadly ovate, entire, pointless: leaves thick, oblong, obtuse, equalling the stipules, and with them densely covering the short stems: flowers immersed among the leaves: sepals oral, awned a little below the apex. — Proc. Phil. Acad. 1863, 58. Alpine. Uinta Mountains, Rocky Mountains of Colorado, and southward.

2. **P. sessiliflora**, Nutt. Very densely caespitose from a woody root, much branched and crowded, branches very dense: stipules 2-cleft: leaves imbricated, linear-subulate, the lowest erect, obtuse, the upper longer, recurved, spreading, acute or mucronate, longer than the stipules: sepals oblong-linear, with divergent awns rather shorter. — Colorado and northward to the headwaters of the Missouri and the Saskatchewan.

* * *Flowers in crowded dichotomous cymes.*

3. **P. Jamesii**, Torr. & Gray. Very minutely scabrous-pubescent, caespitose, much branched from the base: stipules ovate-lanceolate, acuminate or setose: leaves longer, linear-subulate, obtuse, about the length of the internodes: cymes few-flowered, with a central subsessile flower in each division: sepals linear-oblong, with very short cusps. — Fl. i. 170. Colorado.

RANTH FAMILY.)

(AMARANTH FAMILY.)

ules, small flowers which are
have a persistent perianth of
times wanting in *Acnida*),
and opposite them or fewer,
utricular in fruit. Flowers
commonly 3-bracteate.

leaves alternate.

with a calyx of 3 or 5 (sometimes

Flowers

leaves opposite.

ils. Filaments united at base
leaves.

tube. Hairy or woolly, with

AMARANTH.

ar and sessile. Utricle
with leaves thin and
piculate with a short
or spiked clusters or
more numerous pistil-

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spikes: sepals 5:

aves.

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4. **A. blitoides**, Watson. Like the last, but *prostrate or decumbent*: spikelets usually contracted: *bracts ovate-oblong, shortly acuminate, nearly equal; utricule not rugose*: seed nearly a line broad. — Proc. Am. Acad. xii. 273. From Mexico to N. Nevada and Iowa. Known on the plains as "Rolling" or "Tumble Weed."

* * *Sepals (5) of the fertile flowers more or less dilated above and spreading, distinct or united at base: flowers sometimes diœcious: perianth deciduous with the fruit.*

5. **A. Torreyi**, Benth. Bracts scarcely as long as the flowers: sepals obovate-spatulate, rounded above and entire or retuse or emarginate; sepals of the male flowers (which are mingled with the pistillate ones or on distinct plants) oblong-lanceolate, acute. — *Amblygyne Torreyi*, Gray. Colorado, New Mexico, and southward.

2. ACNIDA, L. WATER-HEMP.

Flowers 2 to 3-bracted. Staminate flowers of 5 thin oblong and mucronate-tipped sepals, longer than the bracts, and as many stamens with oblong anthers; the cells of the latter united only at the middle. Pistillate flowers with lanceolate awl-pointed bracts longer than the ovary: stigmas 2 to 5, bristle-awl-shaped. Fruit (in ours) a thin and membranaceous utricule, smooth and even. — An annual glabrous herb, mostly tall, with lanceolate or oblong-ovate leaves, on long petioles, and small clusters of greenish flowers, usually crowded into elongated and panicked interrupted spikes.

1. **A. tuberculata**, Moq. Stigmas very long, divergent, plumose-hispid. — *Montelia tamariscina*, Gray. Low grounds and moist sandy shores from Colorado to Vermont.

3. CLADOTHRIX, Nutt.

Flowers 3-bracted; bracts concave, hyaline. Perianth of 5 erect equal oblong rigid-scarious sepals, somewhat pilose with verticillately branched hairs. Anthers large, oblong. Utricule ovate-globose, indehiscent. — Low annual, or erect and woody at base, with small rounded entire petiolate leaves.

1. **C. lanuginosa**, Nutt. Prostrate or ascending, diffusely branched: leaves round-obovate to rhomboidal, more or less attenuate at base, often in threes: flowers mostly in pairs: sepals twice longer than the broader hairy-tipped bracts. — Bot. Calif. ii. 43. *Alternanthera (?) lanuginosa*, Torr. From S. California eastward through S. Colorado to Arkansas and Texas.

4. FRÆLICHIA, Mœench.

Flowers 3-bracted. Calyx tubular, 5-cleft at the summit, below 2 to 5-crested lengthwise, or tubercled and indurated in fruit, enclosing the indehiscent thin utricule. Tube of filaments bearing 5 oblong anthers and as many sterile strap-shaped appendages. — Herbs with spiked, scarious-bracted flowers.

1. **F. Floridana**, Moq. Root annual: stem leafless above, 1 to 2 feet high: leaves lanceolate, silky-downy beneath: spikelets crowded into an interrupted spike: calyx very woolly. — Colorado and eastward to Illinois.

ORDER 65. CHENOPODIACEÆ. (GOOSEFOOT FAMILY.)

Herbs or shrubs, often succulent or scurfy, usually with simple and alternate leaves, without stipules; the small and sessile commonly clustered flowers either naked or with herbaceous (not scarious) bracts, a perianth of 5 or fewer usually herbaceous and persistent sepals; stamens as many as the sepals and opposite, distinct, with 2-celled anthers; ovary 1-celled, an akene or utricle in fruit. Flowers perfect or unisexual. Bracts often enclosing the fruit. — Watson, Proc. Am. Acad. ix. 82.

§ 1. Flowers perfect, without bracts; the perianth persistent: seed free, mostly with crustaceous testa.

* Seeds horizontal (sometimes vertical in *Chenopodium*).

1. **Kochia**. Perianth 5-cleft, at length transversely winged, enclosing the fruit. Testa membranous. Perennial, with terete leaves and axillary flowers.
2. **Cycloloma**. Perianth 5-cleft, in fruit surrounded by a horizontal continuous membranaceous wing. Annual, much-branched, with sinuate-toothed petioled leaves and small panicle clusters of sessile flowers.
3. **Chenopodium**. Perianth usually 5-cleft or -parted, nearly covering the fruit. Stamens 5, 1, or none. Annuals, mostly mealy or glandular, with clustered or solitary axillary or terminal flowers. Seeds often vertical.

* * Seeds vertical.

4. **Monolepis**. Sepal 1, bract-like. Stamen 1. Fruit naked. Low annuals; flowers densely clustered in the axils.

§ 2. Flowers monœcious or diœcious; the staminate with 3 to 5-cleft perianth; the pistillate without perianth, enclosed in a pair of more or less united bracts: seed free, vertical.

* Bracts compressed: testa mostly coriaceous.

5. **Atriplex**. Fruiting bracts with margins often dilated and sides often mucronate. Radicle from inferior to superior.

* * Bracts obcompressed, completely united, not mucronate: testa membranous.

6. **Grayia**. Pericarp naked, very entire, orbicular, flattened, wing-margined. Radicle inferior. Flowers diœcious. Shrubby, frequently spinescent, nearly glabrous.
7. **Suckleya**. Pericarp naked, subhastate, with crested margins and 2-toothed apex. Radicle superior. Flowers monœcious.
8. **Eurotia**. Pericarp conical, densely hairy, turgid, not winged, with a bifid apex. Radicle inferior. Flowers diœcious. Low and shrubby, white-tomentose.

§ 3. Flowers perfect, without bracts: sepals 1 to 3, hyaline, marcescent: pericarp adherent to the vertical seed.

9. **Corispermum**. Fruit compressed-elliptic, acutely margined, not mucronate. Flowers spicate. Low annual.

§ 4. Flowers mostly perfect, immersed by threes in the depressions of a close cylindrical spike: seeds vertical: fleshy saline plants, with jointed stems and scale-like leaves.

10. **Salicornia**. Flower-clusters decussately opposite. Perianth saccate, becoming spongy. Branches opposite.

§ 5. Embryo spiral (annular in all other sections): leaves fleshy, terete: stems not articulated.

11. **Sarcobatus**. Flowers unisexual; the staminate in aments, without perianth; the pistillate axillary, solitary, with saccate perianth. Fruit transversely winged. Saline shrub, somewhat spinescent.
12. **Suaeda**. Flowers perfect, axillary. Perianth 5-cleft or -parted. Saline herbs, or woody at base.

1. **KOCHIA**, Roth.

Perianth subglobose. Stamens 5, usually exserted. Ovary depressed: styles 2, filiform. Pericarp membranous. — Woody at the base, with scattered linear terete leaves, and the flowers solitary or few in the axils of the virgate leafy stems.

1. **K. Americana**, Watson. Branching at base: stems villous-tomentose or nearly glabrous: flowers 1 to 3 in the axils, mostly with abortive stamens: perianth densely white-tomentose; lobes of the membranous wing cuneate-rounded, nerved and somewhat crenulate: ovary tomentose above. — Proc. Am. Acad. ix. 93. *K. prostrata* of American authors. W. Wyoming to N. W. Nevada and southward to Arizona.

2. **CYCLOLOMA**, Moquin. WINGED PIGWEED.

Calyx with concave lobes strongly keeled, enclosing the depressed fruit. Stamens 5. Styles 3.

1. **C. platyphyllum**, Moq. More or less arachnoid-pubescent; whole plant light green or often deep purple. — From Colorado to the head-waters of the Missouri and eastward to the Mississippi.

3. **CHENOPODIUM**, L. GOOSEFOOT. PIGWEED.

Lobes of the perianth usually somewhat keeled or crested, becoming dry, or rarely at length fleshy. Styles 2, rarely 3 or 4. Pericarp membranous, closely investing the seed. — Flowers, when in clusters, in interrupted spikes or panicles. Many are introduced weeds. Includes *Blitum*, Tourn., and *Telozya*, Moquin.

§ 1. *Not pubescent or glandular, nor aromatic, sometimes somewhat mealy: fruiting calyx dry: seed lenticular, horizontal.*

* Pericarp closely persistent: leaves more or less sinuate-dentate (except in No. 1): seed large ($\frac{3}{4}$ line broad).¹

1. **C. olidum**, Watson. Farinose, heavy-scented: leaves rather thick, oblong to ovate, often slightly hastate, entire: flowers rather large, in close clusters rather loosely panicked. — Proc. Am. Acad. ix. 96. New Mexico and Arizona to Colorado and N. Utah.

2. **C. hybridum**, L. Glabrous throughout or only the inflorescence mealy, rather stout and erect: leaves thin, somewhat triangular and heart-shaped, taper-pointed, sinuate-angled with 2 or 3 large teeth on each side: racemes diffusely and loosely panicked: seed with acutish margin. — A very common weed everywhere, but apparently indigenous within our range in the mountains from New Mexico and Colorado to Washington.

3. **C. glaucum**, L. Glaucons-mealy, low and spreading; upper surface of the leaves smooth: leaves ovate to oblong-lanceolate, sinuate-dentate: flowers clustered in axillary spikes shorter than the leaves: seed sharp-edged. — Proba-

¹ *C. album*, L., a species introduced everywhere, is mealy and pale, sometimes green, with leaves varying from rhombic-ovate to lanceolate, all or only the lower more or less angulate-toothed. It is usually known as "Pigweed" or "Lamb's Quarters."

bly indigenous in Colorado, and on the Saskatchewan; introduced in the Eastern States.

* * *Pericarp separating readily from the seed: leaves entire or hastately lobed: seed smaller.*

4. **C. Fremontii**, Watson. Erect, slender, more or less mealy: *leaves broadly triangular-hastate, truncate or cuneate at base: flowers often small, white-mealy, scattered in small clusters upon the slender open-panicked branchlets, or sometimes more contracted.*—Bot. King Exped. 287. New Mexico and Colorado, and westward to S. California.

Var. **incanum**, Watson. *Densely farinose, low and rather stout: flowers crowded in close contracted panicles.*—Proc. Am. Acad. ix. 94. Colorado and New Mexico.

5. **C. leptophyllum**, Nutt. Densely mealy or often nearly glabrous: *leaves linear, entire: flowers in small dense clusters in dense or interrupted spikelets.*—From the Sierras to the Dakotas and New Mexico; also along the Atlantic sea-coast.

Var. **subglabrum**, Watson. *Nearly glabrous, loosely branched and panicked, the clusters few-flowered and scattered on the branchlets.*—Proc. Am. Acad. ix. 95. Sandhills of the Platte.

Var. **oblongifolium**, Watson. Rather stout, *densely mealy: leaves oblong, often slightly hastate: flowers in dense clusters in short close spikes.*—Loc. cit. Colorado and New Mexico.

§ 2. *More or less glandular-puberulent, aromatic, not mealy: seed very small, not exceeding the dry perianth, horizontal.*

6. **C. cornutum**, Benth. & Hook. Diffusely branched: leaves thin, lanceolate, repand-dentate or coarsely sinuate-pinnatifid: flowers minute and solitary, axillary and terminal upon the repeatedly dichotomous nearly naked branches: calyx resinous-dotted. — *Teloxys cornuta*, Torr. From S. E. California to Arizona, Colorado, and Northern Mexico.

§ 3. *Glabrous: calyx becoming more or less fleshy in fruit and often colored: seed subglobose, mostly vertical: flowers in crowded clusters, axillary or in spikes.*

7. **C. rubrum**, L. *Stout, erect, branching: leaves triangular-hastate to lanceolate, cuneate at base, sparingly sinuate-dentate, the upper narrowly lanceolate and entire: flower-clusters densely spicate upon the leafy branchlets: sepals 2 to 5, rather fleshy: stamens 1 or 2, or 5 in the terminal flowers.*—*Blitum maritimum*, Nutt. *B. polymorphum*, C. A. Meyer. *B. rubrum*, Reich. From New Mexico northward, westward to California, and eastward.

Var. **humile**, Watson. *Smaller, prostrate or ascending: leaves ovate to lanceolate, often hastate, much smaller (an inch long or less), rarely toothed: flowers in axillary or somewhat spicate clusters.*—Bot. Calif. ii. 48. Colorado to Nevada and Washington.

8. **C. capitatum**, Watson. Similar, but with *leaves more broadly triangular, often somewhat hastate, more acutely sinuate-toothed: flower-clusters large, in interrupted terminal naked spikes and solitary in the axils of the upper leaves: calyx becoming fleshy in fruit, and the clusters red and berry-like.*—Bot.

Calif. ii. 48. *Blitum capitatum*, L. From New Mexico to Washington and the Saskatchewan, also eastward. Sometimes called "Strawberry Blite."

4. **MONOLEPIS**, Schrad.

Flowers polygamous. The single sepal becoming dry in fruit. Styles 2. Pericarp membranous, persistent upon the vertical flattened seed.—Low saline annuals, glabrous or somewhat mealy, with small alternate petioled fleshy leaves.

1. **M. chenopodioides**, Moq. Branched from the base: leaves lanceolate-hastate or sometimes narrowly spatulate, entire or sparingly sinuate-dentate, cuneate or attenuate at base; lower petioles elongated: flower-clusters often reddish: pericarp fleshy, becoming dry and minutely pitted.—From Arizona to N. E. California, the Saskatchewan, and Texas.

5. **ATRIPLEX**, Tourn.

Staminate flowers without bracts. The erect bracts of the pistillate flowers becoming enlarged and enclosing the fruit. Styles 2. Pericarp thin and membranous.—Herbs or shrubs, mealy or scurfy: leaves rarely opposite: flowers usually clustered, axillary or in simple or paniced spikes, the sexes distinct or mingled in the clusters.—*Obione*, Moquin. For satisfactory determination of the species well-matured fruiting bracts are necessary.

* *Annuals, somewhat succulent and mealy: leaves triangular-hastate, large: bracts nearly distinct, triangular or hastate, foliaceous-margined.*

1. **A. patula**, L. Dark green: leaves lanceolate-hastate, the lower ones opposite, entire or sparingly sinuate-toothed, petioled, the upper lanceolate to linear: flowers in naked and usually somewhat interrupted spikes, the lower clusters axillary: fruiting bracts ovate-triangular or rhombic-hastate, united at base, with a broad herbaceous entire or toothed margin.—Across the continent in salt or brackish localities. Very variable, the following varieties being the best defined within our range.

Var. hastata, Gray. The lower leaves at least broadly triangular-hastate, entire or toothed with shallow sinuses.—Ranging southward to Central Colorado.

Var. subspicata, Watson. A low form, usually quite scurfy: leaves lanceolate-hastate, $\frac{1}{2}$ to 1 inch long.—Ranging farther north than the last, from the Missouri to the Saskatchewan.

* * *Annuals, not succulent, mealy or scurfy: leaves smaller: bracts more or less united, not triangular or hastate, nor greatly enlarged.*

+ *Bracts ovate, entire and not foliaceous nor appendaged.*

2. **A. Endolepis**, Watson. Leaves thin, lanceolate, sessile, entire: male flowers in short terminal and axillary spikes, lobes of the calyx with a fleshy crest upon the back; pistillate flowers solitary in the lower axils, sessile: bracts pubescent.—Proc. Am. Acad. ix. 110. Upper Missouri and head-waters of the Yellowstone.

+ + *Bracts small, ovate-oblong, truncate, usually few-toothed.*

3. **A. saccaria**, Watson. Low (3 to 5 inches high), diffusely branched, densely scurfy: *leaves subcordate-ovate*, very shortly petioled or sessile: flowers axillary: *bracts pedicelled* and often deflexed, *the truncate summit entire or suberose*. — Loc. cit. 112. S. Wyoming (*Dr. Gray*).

4. **A. Wolfii**, Watson. Low, branching, scurfy-canescens and reddish: *leaves linear, sessile*: flowers very small, in androgynous axillary clusters: *bracts sessile, 3-toothed*. — Loc. cit. Central Colorado (*Wolf*).

+ + + *Bracts orbicular, tooth-crested, with an acuminate foliaceous apex.*

5. **A. Powellii**, Watson. Erect, slender, grayish: leaves lanceolate, entire or subdentate: flowers androgynous, axillary: bracts with a broad terminal entire lobe, the margin below it gash-toothed, the sides doubly or triply tooth-crested. — Loc. cit. S. W. Colorado and Arizona.

+ + + + *Bracts rhombic-orbicular, indurated, usually conspicuously appendaged and the foliaceous margin toothed and undulate: leaves triangular and subhastate, the lower opposite.*

6. **A. argentea**, Nutt. Diffusely branched and leafy, grayish scurfy or nearly glabrous: *leaves petioled*: *male spikes short and dense*: bracts shortly-pedicelled. — *Obione argentea*. From Colorado to the Upper Missouri and N. E. California.

7. **A. expansa**, Watson. Like the last, but stouter, *more divaricately and distantly branched*, with thinner leaves, *sessile*, and *the male spikes elongated, slender and leafless toward the apex*. — Loc. cit. 116. S. Colorado and New Mexico to S. California.

* * * *Perennials, shrubby, densely appressed-scurfy.*

+ *Bracts with a toothed margin and the sides muricate.*

8. **A. Nuttallii**, Watson. Branching from the shrubby base: leaves oblong-spatulate to narrowly oblanceolate, entire: bracts ovate, strongly convex, united, the sides more or less crested. — Loc. cit. 116. *A. canescens*, Nutt. *Obione canescens*, Moq. From Colorado to N. Nevada and the Saskatchewan.

+ + *Bracts with free dilated entire margins, thick and scurfy, and the sides not muricate.*

9. **A. confertifolia**, Watson. Diffusely-branched, somewhat spinescent: leaves ovate to obovate, cuneate at base, entire: flower clusters small, axillary: bracts cuneate-orbicular, united at base. — Loc. cit. 119. *Obione confertifolia*, Torr. From S. Idaho and Wyoming to New Mexico and southward.

+ + + *Bracts connate and indurated, not scurfy or muricate, with 4 distinct broadly dilated wings.*

10. **A. canescens**, James. Leaves oblanceolate to narrowly oblong or linear, entire: flowers mostly dioecious, in panicle spikes: the bracts forming a thick and indurated body, shortly pedicellate and with a narrow bifid apex, the broad wings somewhat decurrent upon the pedicel. — Watson, loc. cit. 120. From N. Nevada to Colorado, New Mexico, and S. California.

6. GRAYIA, Hook. & Arn.

Calyx mostly 4-parted. Bracts with a small naked orifice at the apex, net-veined. — Slightly scurfy or mealy undershrubs: leaves alternate, entire: flowers small, in axillary clusters or terminal spikes.

1. *G. polygaloides*, Hook. & Arn. Erect, 1 to 3 feet high, the branches frequently spinescent: leaves glabrous or at first with the young branches somewhat mealy, oblanceolate or spatulate to obovate: staminate flowers in axillary clusters; the pistillate mostly spicate: fruiting bracts glabrous, emarginate, white or pinkish, adherent below to the pedicel of the ovary: styles slender, at first exserted. — On alkaline soil eastward of the Sierras from the Columbia to Wyoming, Utah, and S. E. California.

2. *G. Brandegei*, Gray. Lower and unarmed, more mealy: leaves linear-spatulate: fruiting bracts smaller, slightly mealy, revase at base, sometimes 3-winged; wings somewhat undulate: ovary sessile, style short, included. — Proc. Am. Acad. xi. 101. S. W. Colorado.

7. SUCKLEYA, Gray.

An annual, with branching prostrate stems, suborbicular leaves on long petioles, and flowers in axillary clusters.

1. *S. petiolaris*, Gray. Leaves acutely repand-dentate, pale green on both sides, nearly glabrous: bracts of the sessile fruit deltoid: male flowers tetramerous. — *Obione Suckleyana*, Torr. Near Denver (Meehan).

8. EUROTIA, Adamson.

Calyx 4-parted. Stamens with slender exserted filaments. Styles 2, somewhat hairy, exserted. — Stellately tomentose undershrubs: leaves entire: flowers in small axillary and somewhat spicate clusters.

1. *E. lanata*, Moq. White-tomentose throughout: leaves linear to narrowly lanceolate, with revolute margins: calyx-lobes hairy: fruiting bracts lanceolate, nearly covered by four dense spreading tufts of long silvery-white hairs, and beaked above with two short horns. — From New Mexico to Oregon and the Saskatchewan. Known as "White Sage" or "Winter Fat."

9. CORISPERMUM, Ant. Jussieu. BUG-SEED.

Perianth usually of one sepal, erose or lacerate at the apex. Stamens 1 to 5, unequal. — Low, branching, pale green: leaves sessile, mostly narrow: flowers spicate, solitary in the axils of reduced bracts.

1. *C. hyssopifolium*, L. Somewhat floccose or villous-pubescent, at least when young: leaves linear, cuspidate: spikes short and close, becoming more or less elongated: central stamen longest, the lateral ones partly developed or wanting. — From New Mexico to the Arctic regions, and from California to the Great Lakes.

10. **SALICORNIA**, Tourn. GLASSWORT. SAMPHIRE.

Calyx a fleshy rhomboidal sac with an anterior opening, adherent by a narrow line to the rhachis. Stamens 1 or 2, exserted in flower. Styles 2 or 3, short. — Low fleshy leafless saline plants, mostly herbaceous: spikes cylindrical.

1. **S. herbacea**, L. Erect or at length spreading, green: spike very thick and fleshy: scales obscure and very blunt, making a truncate barely emarginate termination of the joints of stem or elongated spike. — In salt marshes from Colorado and Utah to the Saskatchewan and along the Atlantic coast.

11. **SARCOBATUS**, Nees. GREASEWOOD.

Flowers monœcious or diœcious, without bracts. Stamens 2 to 5, irregularly arranged under a stipitate peltate scale; anthers fleshy. Perianth adherent at the contracted somewhat 2-lipped apex to the base of the stigmas, laterally margined by a narrow erect slightly 2-lobed border, which at length becomes a broad circular horizontal membranous veined wing. Style lateral, terminated by two thick exserted unequal stigmas. — A rigidly and divaricately branched shrub: leaves linear.

1. **S. vermiculatus**, Torr. Erect and scraggy, 2 to 8 feet high, leafy; branches with a smooth white bark: staminate spikes terminal, the persistent scales spirally arranged, rhombic-ovate. — Common in the Great Basin, and to the Upper Missouri, head-waters of the Platte, and southward. The commonest of the several shrubs called "Greasewood."

12. **SUÆDA**, Forskal. SEA BLITE.

Flowers minutely bracteolate. Lobes of the calyx unappendaged or more or less strongly keeled or crested, or at length somewhat winged. Testa shining, black, and crustaceous. — Flowers axillary along the branches, clustered or solitary, sessile.

* *Herbaceous annuals.*

1. **S. diffusa**, Watson. Erect, diffusely branching: *leaves subterete; the floral ones similar but shorter, usually rather distant on the branchlets: clusters 2 to 4-flowered: calyx cleft to below the middle, not carinate or appendaged.* — Proc. Am. Acad. ix. 88. *S. maritima* of Bot. King Exped. From the Upper Missouri to California, Mexico, and Texas.

2. **S. depressa**, Watson. Low and mostly decumbent, branching from the base: *leaves linear, broadest at base; the floral ones oblong- to ovate-lanceolate or ovate, rather crowded on the branchlets: calyx cleft to the middle, one or more of the lobes strongly carinate or crested.* — Bot. King Exped. 294. From Colorado to Nevada and the Saskatchewan.

Var. **erecta**, Watson. Erect, with very narrow leaves and narrower bracts. — Proc. Am. Acad. ix. 90. *S. maritima* of Fl. Colorado. Same range as the type, but extending into S. California.

* * *Woody-based perennials.*

3. **S. Torreyana**, Watson. Erect, with herbaceous leafy branches: leaves linear, subterete, the floral ones similar: calyx rather large, deeply cleft: seed finely tuberculate. — Loc. cit. 68. *S. fruticosa* of Bot. King Exped. From N. Colorado to Nevada, S. California, and Mexico.

ORDER 66. **POLYGONACEÆ.** (BUCKWHEAT FAMILY.)

Herbs, with alternate and entire leaves, or sometimes verticillate, and stipules in the form of sheaths above the swollen joints of the stem or none; flowers mostly perfect, with a more or less persistent calyx, a 1-celled ovary bearing 2 or 3 styles or stigmas, and a single erect seed; stamens mostly 4 to 9. Flowers rather small, the perianth of 3 to 6 segments, the inner ones or all usually petaloid; fruit an akene.

* Flowers involucre: stamens 9: styles 3, with capitate stigmas: herbs or woody at base, with alternate or verticillate leaves, without stipules.

1. **Eriogonum.** Involucre several-flowered, with 4 to 8 pointless teeth. Flowers exserted. Akene mostly 3-angled. Annuals or perennials.

2. **Oxytheca.** Involucre few-flowered, herbaceous, with 3 to 5 straight acute or usually awned lobes. Flowers on exserted pedicels. Akene lenticular. Bracts ternate. Annuals.

** Flowers without involucre: stamens 4 to 8: styles 2 or 3: herbs with alternate leaves and scarious sheathing stipules; juice usually acid, acrid or pungent.

3. **Oxyria.** Sepals 4, the outer smaller and spreading. Stigmas 2, tufted. Akene orbicular-winged. Leaves reniform.

4. **Rumex.** Sepals 6, the outer spreading, the inner enlarging and appressed to the triangular akene. Stigmas 3, tufted.

5. **Polygonum.** Sepals 4 to 6, equal, appressed to the triangular or lenticular akene. Styles 2 or 3: stigmas capitate.

1. **ERIOGONUM**, Michx.

Involucre campanulate, turbinate or oblong. Perianth 6-parted, colored, enclosing the akene. — Herbaceous or somewhat woody, with radical or alternate or verticillate leaves.

§ 1. *Involucres more or less broadly turbinate, not nerved or angled, 4 to 8-toothed or lobed: bracts foliaceous, rarely somewhat ternate.*

* *Akenes membranously winged.*

1. **E. alatum**, Torr. Loosely silky-villous throughout, or the leaves nearly glabrous except on the margin and midrib: leaves alternate, long, oblanceolate: involucre pedunculate, solitary, with 5 erect teeth: flowers a line long, yellow, nearly glabrous, abrupt at base: akene winged the whole length. — From Arizona and Texas to Nebraska.

** *Akenes not winged.*

+ *Flowers glabrous.*

2. **E. umbellatum**, Torr. Tomentose: leaves glabrate above or glabrous, oblanceolate or spatulate: involucre deeply lobed; lobes becoming reflexed: *umbel simple, of 2 to 10 naked rays, on naked (rarely 1-bracted) peduncles.* — From Colorado to Oregon and California.

Var. **monocephalum**, Torr. & Gray. A reduced dwarf alpine form, the naked or bracteate peduncle bearing a solitary involucre: leaves small.

3. **E. heracleoides**, Nutt. Similar, but the *peduncle usually verticillate-bracted: leaves narrower, mostly somewhat revolute or undulate: umbel 6- (1-11-)*

rayed, usually some or all of the rays once or twice divided. — From Colorado to Nevada and Washington.

+ + Flowers not glabrous.

+ + Leafy: flowers not attenuate at base.

4. **E. salsuginosum**, Hook. Low, glabrous, somewhat fleshy, di- or trichotomously divided: leaves spatulate-oblancoate, the bracts becoming linear: involucre divided: flowers pubescent, yellow: sepals narrow, closely appressed to the acutely triangular glabrous akene. — From S. W. Colorado to Utah and W. Wyoming.

+ + Naked or nearly so: flowers attenuate at base.

= Bracts conspicuous: akenes glabrous or nearly so.

5. **E. Jamesii**, Benth. Rather slender, herbaceous, with branching caudex, a foot high or less, white-tomentose: leaves and bracts oblong-oblancoate, the latter shortly petiolate: involucre solitary, sessile, with 5 erect teeth, on a naked peduncle: flowers whitish, silky. — Colorado, New Mexico, and Arizona.

Var **flavescens**, Watson. Stouter: flowers yellow or yellowish. — Distinguished from the next by the strictly solitary sessile involucre.

6. **E. flavum**, Nutt. Tomentose throughout, a span high or less: leaves oblancoate: umbel of 3 to 9 rays, simple, on a naked peduncle: flowers yellow, very silky. — Colorado to Washington and the Saskatchewan.

7. **E. cespitosum**, Nutt. Dwarf, densely matted: leaves ovate-to oblong-spatulate, tomentose on both sides: involucre solitary on naked peduncles: flowers yellow, pubescent. — From Wyoming to Nevada.

8. **E. sphærocephalum**, Dougl. Similar, but larger and much more diffused: leaves linear-spatulate, often revolute: peduncles with a whorl of oblancoate bracts sometimes subtending a 2 to 4-rayed umbel, the lateral rays also bracteate: flowers yellow, pubescent. — Nevada and California to Washington, and extending thence eastward into Montana.

= = Bracts small: akenes densely villous.

9. **E. acaule**, Nutt. Very dwarf and densely matted and tomentose: leaves crowded, oblong: peduncles naked, $\frac{1}{2}$ inch high, bearing a head of 1 to 5 nearly sessile involucre: flowers pubescent. — S. W. Colorado to S. Idaho.

10. **E. lachnogynum**, Torr. Cespitose and densely tomentose: leaves oblong-lanceolate: the slender naked peduncle a foot high, sparingly dichotomous above: involucre solitary, sessile or long pedunculate: flowers densely tomentose. — S. Colorado and New Mexico.

§ 2. Involucre campanulate or short-turbinate, not nerved or angled, with 5 rounded erect teeth, pedunculate in diffuse repeatedly di- or trichotomous panicles: bracts not foliaceous, all ternate: flowers not attenuate at base: ovary glabrous.

* Leaves tomentose.

+ Stems simple, leafy, naked above.

11. **E. annuum**, Nutt. Tall and stout: leaves narrowly oblancoate or oblong, attenuate to a short petiole, mostly flat: inflorescence cymose: involucre densely white-tomentose: flowers white: sepals very unequal, the outer oblong-obovate. — Colorado to Texas and Mexico.

+ + *Branching: leaves radical or at least the peduncles leafless.*

+ + *Densely white-tomentose.*

12. **E. tenellum**, Torr. Tall: branches of the woody caudex short and crowded or elongated: leaves ovate or rounded, tomentose on both sides: inflorescence rather sparingly branched, glabrous: flowers white or pinkish: outer sepals broadly obovate or orbicular, the inner linear-oblong. — S. Colorado to Texas and Mexico.

+ + *Glabrous: involucre turbinate-campanulate.*

13. **E. cernuum**, Nutt. *Leaves broadly ovate, acute: pedicels deflexed:* outer sepals oblong or broader above, retuse. — New Mexico and Colorado to Oregon.

14. **E. reniforme**, Torr. Low and slender: *leaves reniform or cordate-orbicular*, densely white-tomentose on both sides: bracts smooth, *the margins ciliate: pedicels long and filiform, rarely deflexed*, all in the forks or terminating the branches: *flowers rose-colored*, glabrous. — S. W. Colorado to S. California.

15. **E. Thomasii**, Torr. Low and very slender: *leaves rounded and ovate, small: bracts minute, glabrous: pedicels as in the last: flowers yellowish*, often reddish, slightly hispid or glabrous: outer sepals often much dilated below. — S. W. Colorado to S. California.

* * *Leaves not tomentose.*

+ *Leaves all radical or nearly so.*

16. **E. inflatum**, Torr. Glabrous, diffusely branching, *the stem and internodes often inflated: leaves rounded, usually cordate and mostly undulate, pubescent: flowers yellowish, pubescent.* — S. W. Colorado to Arizona, Nevada, and S. California.

17. **E. Gordonii**, Benth. A similar species; but *glabrous throughout*, or the petioles slightly pubescent: *flowers glabrous, light rose-color.* — Colorado.

18. **E. glandulosum**, Nutt. *Beset with short-stipitate glands: leaves small, obovate, somewhat villous: involucre glabrous: flowers slightly hispid.* — Collected by Dr. Gambel in Colorado or New Mexico.

+ + *Leaves developed at the nodes in the axils of ordinary triangular bracts.*

19. **E. divaricatum**, Nutt. Low, grayish-pubescent, branching from the base, branches terete: leaves thickish, all rounded or the upper oblong, petiolulate: involucre very small and few-flowered: flowers whitish, minutely glandular: sepals nearly equal. — W. Wyoming to S. W. Colorado.

§ 3. *Involucre cylindric-turbinate, more or less strongly 5 to 6-nerved, and often becoming costate or angled, with as many short erect teeth, sessile in heads or clusters, or scattered in cymes or along virgate paniced branches: bracts ternate, connate at base, more or less rigid: flowers not attenuate at base.*

* *Outer sepals broad and somewhat cordate, the inner much narrower: ovary scabrous above.*

20. **E. ovalifolium**, Nutt. Low, densely tomentose and cespitose, with a short closely branched caudex: leaves round or rarely oblong: bracts very small: involucre in a single close head: flowers rose-colored, white, or yellow: outer sepals oblong, becoming orbicular, the inner spatulate, often retuse. — From Colorado to N. California and British America.

* * *Sepals similar and nearly equal: akenes smooth or nearly so.*

+ *Involucres capitate, heads solitary: dwarf and caespitose, alpine or subalpine, densely white-tomentose.*

21. **E. pauciflorum**, Nutt. Caudex short-branched: tomentose throughout, or the linear-oblongolate revolute leaves glabrous above: involucres broadly turbinate, nearly glabrous, thin, with broad somewhat scarious teeth: flowers white, glabrous. — Colorado.

22. **E. chrysocephalum**, Gray. Caudex more diffusely branched, woody: tomentose throughout, the narrowly oblongolate leaves sometimes glabrate above: involucres narrower and rather more firm, shortly toothed, somewhat tomentose: flowers yellow, glabrous. — Proc. Am. Acad. xi. 101. Wasatch Mountains.

23. **E. multiceps**, Nees. Rather diffusely branched at base, densely white-tomentose throughout: leaves narrowly oblongolate: involucres rigid, narrowly turbinate, with very short teeth: flowers rose-colored, pubescent. — Nebraska to Colorado.

+ + *Involucres mostly solitary, in a repeatedly di- or trichotomous corymb-like cyme.*

24. **E. microthecum**, Nutt. Low and rather slender, woody and diffusely much-branched, leafy below, more less white-tomentose: leaves usually narrow, revolute, becoming glabrate above: involucres often pedunculate: inner sepals emarginate. — From Nebraska to New Mexico, the Sierra Nevada, and Oregon.

Var. **effusum**, Torr. & Gray. With very diffuse and repeatedly divided inflorescence. — More common eastward.

25. **E. corymbosum**, Benth. Stouter and more rigid, usually densely tomentose: leaves broader and less revolute: umbel stiff and broadly cymose: involucres mostly sessile. — Including *E. microthecum*, var. *Fendlerianum*, Benth. Same range as last.

26. **E. brevicaule**, Nutt. Less woody and more shortly branched at base, glabrous or glabrate above the white-tomentose base: leaves linear to narrowly oblongolate, attenuate to a very short petiole, often revolute, sometimes glabrate above: flowers yellow. — Idaho and Wyoming to New Mexico.

+ + + *Involucres sessile and solitary upon the few strict branches of the once or twice forked panicle.*

27. **E. racemosum**, Nutt. White-tomentose, sparingly or not at all branched at base, stout, 1 to 3 feet high: leaves large, ovate to oblong, on long petioles: lower bracts somewhat foliaceous: involucres approximate, tomentose: flowers white or rose-colored. — S. W. Colorado to Utah and New Mexico.

2. OXYTHECA, Nutt.

Flowers, bracteoles, etc., as in *Eriogonum*. — Slender diffusely branched (repeatedly dichotomous) annuals, the slender internodes more or less covered with small stipitate glands: leaves rosulate at the base: segments of the glandular-pubescent perianth similar and equal.

1. **O. dendroidea**, Nutt. A foot high or less, the scape-like stem

usually 1 or 2 inches high: leaves linear-oblongate, hirsute: bracts unequal: involucre in the forks on slender pedicels, the rest more nearly sessile: flowers light rose-color. — From Wyoming to Nevada.

3. OXYRIA, Hill. MOUNTAIN SORREL.

Flowers perfect. The two inner sepals erect, appressed, and unchanged in fruit. Stamens 6. — Perennial alpine and arctic herbs, erect, with long-petioled round-reniform mostly radical leaves, and small obliquely truncate sheaths: flowers small and greenish, in narrowly paniced racemes.

1. *O. digyna*, Campdera. Rather stout and fleshy, 3 to 18 inches high, glabrous: flowers in scarious-bracted fascicles, on short capillary pedicels: sepals often reddish, the outer narrower and carinate. — At high altitudes in cold wet places among rocks throughout the northern hemisphere.

4. RUMEX, L. DOCK. SORREL.

Flowers perfect, polygamous, or diœious. Inner sepals somewhat colored and becoming reticulated (*valves*) in fruit. Stamens 6. — Coarse perennial herbs: stems leafy, with obliquely truncate cylindrical naked sheaths: flowers small, fascicled or verticillate in paniculate racemes.

§ 1. *Flowers perfect or polygamous: valves enlarged, often bearing a grain-like callosity on the back: leaves never hastate, pinnately many-veined, rarely very acid.* — DOCKS.

* *Valves wholly without grains, mostly very large (3 lines long or more), entire or denticulate: pedicels long, jointed near the base: glabrous.*

1. *R. venosus*, Pursh. Stems erect, a foot high or less, from running rootstocks, stout and leafy, with conspicuous dilated stipules: leaves on short but rather slender petioles, ovate or oblong to lanceolate, 3 to 6 inches long, only the lowest acute or somewhat cordate at base: panicle nearly sessile, short, dense in fruit: valves entire, cordate orbicular with a deep sinus, 9 to 12 lines in diameter, bright rose-color. — From Colorado and Nevada to British Columbia and the Saskatchewan.

2. *R. occidentalis*, Watson. Tall and rather slender, often 3 to 6 feet high: leaves oblong-lanceolate, the lowest sometimes ovate, usually narrowing gradually upward from the truncate somewhat cordate base, not decurrent on the slender often elongated petiole, often a foot long or more: panicle narrow, elongated, nearly leafless: valves broadly cordate, with a very shallow sinus, 3 lines in diameter, often denticulate near the base. — Proc. Amer. Acad. xii. 253. *R. longifolius* of authors, not of DC. From New Mexico and Colorado to Labrador and Alaska.

* * *Valves smaller, one or more of them grain-bearing.*

3. *R. salicifolius*, Weinman. Slender, often low, 1 to 5 feet high, usually branching and decumbent at base, glabrous: leaves narrowly or linear-lanceolate, or the lowest oblong, 3 to 6 inches long, attenuate into a short petiole, not undulate, glaucous: panicle usually open, the flowers crowded upon the branches: valves ovate-rhomboidal to broadly deltoid, entire or denticulate, usually with very large callosities. — Across the continent and northward to Alaska.

4. **R. maritimus**, L. Simple or diffusely branched, the low stems erect or procumbent, *minutely pubescent*: leaves linear lanceolate, *usually truncate or cordate at base*, 1 to 4 inches long, mostly on short petioles, *somewhat wavy-margined*: flowers in numerous dense verticils along the slender branches: valves ovate-lanceolate, with 2 or 3 long-awned teeth on each side, all grain-bearing. — From the Sierra Nevada eastward across the continent.

§ 2. *Flowers dioecious or polygamous in naked panicles: valves not grain-bearing: leaves often hastate, sparingly veined: stems erect and slender, glabrous.*¹

5. **R. paucifolius**, Nutt. Roots thickened: leaves narrowly to linear-lanceolate, or the lowest broader, attenuate to a slender petiole, not very acid: flowers reddish, in loose fascicles; pedicels filiform, jointed at base: valves enlarged in fruit, cordate-ovate, entire, twice longer than the akene. — From Utah and Montana to the Sierra Nevada and Washington.

5. POLYGONUM, L. KNOTWEED.

Flowers perfect. — Annual or perennial leafy herbs, rarely woody at base: sheaths naked, ciliate, or foliaceous-margined: flowers small, in axillary, spicate, or racemose fascicles.

§ 1. *Flowers in axillary fascicles or spicate with foliaceous bracts: leaves and bracts jointed upon a very short petiole adnate to the naked 2-lobed or lacerate sheath: perianth 5 to 6-parted, more or less herbaceous, close-appressed to the akene: stamens 3 to 8, the three inner filaments broad at base: styles 3: akene triangular. — AVICULARIA.*

* *Flowers in the axils of leaves or in loose virgate spikes: sepals herbaceous or colored only on the margin.*

+ *Branches leafy to the summit: sheaths short and mostly scarious, at length lacerate.*²

1. **P. erectum**, L. Rather stout, erect or ascending, glabrous, usually tinged with yellow: leaves oblong or oval: flowers often yellowish, on more or less exserted pedicels: sepals and stamens 5, rarely 6: akene very broadly ovate to lanceolate, dull and granular to nearly smooth and shining. — From Colorado to Nevada and Oregon and the Eastern States.

2. **P. minimum**, Watson. Very low and slender, ascending, rarely 6 inches high, usually more or less scabrous-puberulent: stems nearly terete, reddish: leaves ovate to oblong, sometimes all narrowly lanceolate: flowers in all the axils, usually small, erect on slender exserted pedicels, often tinged with rose-color: stamens 5 to 8: akene smooth and shining. — Bot. King Exped. 315. *P. Torreyi*, Watson, Am. Nat. vii. 664. From the Wasatch and Uintas to California and Oregon.

¹ *R. Acetosella*, L., is the common "Sorrel" of fields and gardens, spread everywhere from Europe. It can be distinguished from *R. pauciflorus* by its slender running roots, more hastate and very acid leaves with the lobes often toothed at base, pedicels very short and jointed at the top, and the valves not enlarged nor exceeding the small akene.

² *P. aviculare*, L., may be known by its prostrate or spreading habit, sessile lanceolate or oblong leaves, dull broadly ovate akene which is minutely granular under a lens. — Introduced from Europe and growing everywhere about yards and roadsides. Variouslly called "Knot-grass," "Goose-grass," or "Door-weed."

+ + *Branches slender and virgate, angled, terminating in more or less open spikes, the narrow leaves diminishing upward and becoming bract-like.*

3. **P. ramosissimum**, Michx. Erect or ascending, usually 2 to 4 feet high, often branching only above, glabrous, the whole plant yellowish: sheaths loose, becoming lacerate to the base: leaves lanceolate to linear: flowers and fruit as in *P. erectum*, the sepals more frequently 6, stamens 3 to 6, and akene usually smooth and shining. — From the Sierra Nevada eastward across the continent.

4. **P. tenue**, Michx. Erect and slender, $\frac{1}{2}$ to $1\frac{1}{2}$ feet high, glabrous and somewhat glaucous, sometimes slightly scabrous at the nodes: sheaths with a close somewhat herbaceous base, sparingly scarious and lacerate above: leaves linear to lanceolate, usually much reduced above: flowers often solitary and usually distant, soon reflexed, the sepals margined with white or rose-color: stamens 8: akenes ovate, black and shining. — From Arizona to British Columbia and eastward across the continent. The following varieties occur in the Rocky Mountains: —

Var. **latifolium**, Engelm. With broader leaves and more numerous flowers.

Var. **microspermum**, Engelm. A low slender form, with minute flowers and fruit.

* * *Low and slender: flowers in short dense spikes, with imbricated bracts: sepals colored: leaves linear.*

5. **P. imbricatum**, Nutt. Stem 1 to 8 inches high, smooth or slightly scabrous at the nodes, often diffusely branched: sheaths rather large, 2 parted or lacerate above the short scarious base: bracts with sometimes a scarious margin: flowers nearly sessile, rose-colored or white: stamens 3 or 5: akene minutely tuberculate-striate or smoothish. — Alpine and subalpine, from Colorado to California and Oregon. It has usually been referred to *P. coarctatum*.

§ 2. *Flowers fascicled, in usually dense spikes, with small scarious bracts: leaves not jointed on the petiole: sheaths cylindrical and truncate, scarious, entire, naked or ciliate-fringed or margined: perianth colored, 5-parted, appressed to the lenticular or triangular akene: stamens 4 to 8; filaments filiform. —*

PERSICARIA.

* *Sheaths and bracts not ciliate nor fringed: sepals not punctate: style 2-cleft, and akene flattened or lenticular.*

6. **P. Pennsylvanicum**, L. Stem 1 to 3 feet high, smooth below, the branches above and especially the peduncles beset with bristly-stalked glands: leaves lanceolate, roughish on the midrib and margins: spikes oblong, obtuse, erect, thick: flowers bright rose-color: stamens mostly 8, somewhat exerted. — Colorado and eastward to the Atlantic States.

7. **P. incarnatum**, Ell. Stem 3 to 6 feet high, nearly glabrous, the peduncles, etc. often minutely rough with scattered sessile glands: leaves rough on the margins and midrib, elongated-lanceolate: spikes linear, nodding, becoming slender: flowers smaller than in the last, lighter rose-color shading to white: stamens 6 and styles 2, both included. — Colorado and eastward to the Atlantic States.

8. **P. lapathifolium**, Ait., var. **incanum**, Koch. Lower, with shorter and less pointed leaves, which are lanceolate, obtuse, and white-downy beneath:

sheaths often somewhat hairy or ciliate: *spikes shorter, oblong and blunt.* — In the Wahsatch, on the Saskatchewan, and eastward to New York. Rare.

9. **P. nodosum**, Pers. *Often stout, 1 to 4 feet high, branching, mostly glabrous, often sparingly and minutely glandular on the peduncles: leaves rather narrowly lanceolate, cuneate at base and shortly petioled, somewhat scabrous with short prickly hairs on the midrib and margins: spikes axillary and terminal, oblong and erect or often linear and nodding: flowers white or light rose-color: stamens 6 and styles 2, included.* — Colorado and New Mexico to Arizona, California, and Oregon.

10. **P. amphibium**, L. *Aquatic, stout and glabrous or nearly so, not branching above the rooting base: leaves floating, thick, smooth and shining above, usually long-petioled, elliptical to lanceolate, cuneate or cordate at base: sheaths leaf-bearing at about the middle: spike terminal, dense, ovate or oblong, $\frac{1}{2}$ to 1 inch long, on a usually short peduncle: flowers bright rose-color: the 5 stamens and 2-cleft style exerted.* — From the Sierra Nevada eastward across the continent. In shallow water or on muddy banks the stems become erect, the petioles shorter, and the whole plant more strigose-pubescent.

11. **P. Muhlenbergii**, Watson. *In muddy or dry places, scabrous with short appressed or glandular hairs, especially upon the leaves and upper part of the simple stem: leaves thinner and longer, rather broadly lanceolate, narrowly acuminate, usually rounded or cordate at base: spikes more elongated, 3 inches long, often in pairs: flowers and fruit nearly as in the last.* — *P. amphibium*, var. *terrestre*, of Gray's Manual. Across the continent.

* * *Sheaths and bracts bristly ciliate or the sheaths sometimes foliaceously margined.*

12. **P. Hartwrightii**, Gray. *Closely allied to the two preceding species, growing usually in the mud, the ascending stems rooting at the base and very leafy, more or less rough hairy, at least on the sheaths and bracts: leaves rather narrow, on very short petioles, not punctate, adnate to the middle of the sheath: flowers bright rose-color: sepals not glandular-dotted: style 2-cleft, and akene somewhat flattened.* — Proc. Am. Acad. viii. 294. From California and Utah eastward through the Northern States.

13. **P. Hydropiper**, L. *Smooth, 1 to 2 feet high, juice very acrid: leaves punctate: spikes nodding, usually short or interrupted: flowers mostly greenish: sepals conspicuously dotted: stamens 6: style 2 to 3-parted: akene dull, minutely striate, either flat or obtusely triangular.* — Ranging across the continent northward, where it is probably indigenous.

§ 3. *Glabrous alpine or subalpine herbs, with thick creeping rootstocks and simple stems: flowers in dense spike-like racemes: leaves not jointed on the petiole: sheaths obliquely truncate, naked, as well as the scarious ovate or lanceolate bracts: perianth colored, deeply 5-cleft, at length appressed to the triangular akene: stamens 8, with filiform filaments: styles 3, long.* — **BISTORTA**.

14. **P. Bistorta**, L. *Stems a foot or two high: leaves few, the radical ones on long petioles, oblong-lanceolate to linear, acute at each end, the cauline much reduced, mostly obtuse at base and sessile upon the sheath, the margin often slightly revolute: flowers rose-colored to white, on slender pedicels, in very dense ovate to oblong spikes and usually long-pedunculate: stamens*

and styles exerted: akene smooth and shining. — Throughout the northern hemisphere; frequent in meadows and on stream-banks in the mountains. The leaves vary much, from cordate and oblong (var. *oblongifolium*, Meisn.) to very narrow and attenuate at base (var. *linearifolium*, Watson).

15. **P. viviparum**, L. A similar species, but mostly dwarf and more exclusively alpine: flowers smaller, nearly sessile in linear spikes 1 to 3 inches long, at least the lower ones replaced by sessile bulblets a line long. — Same range as the last.

§ 4. Herbs with fibrous roots, mostly twining or climbing, and with cordate or sagittate leaves: flowers in loose panicles or racemes or in terminal or axillary clusters: perianth green with colored margins, 5-parted, enlarging or keeled in fruit: stamens mostly 8: styles or stigmas 3.¹ — **TINARIA.**

16. **P. dumetorum**, L., var. **scandens**, Gray. Smooth, twining high over bushes, with cordate or slightly halberd-shaped acute leaves, and flowers in slender axillary sparingly leafy racemes: perianth long-attenuate to the slender reflexed pedicel; the outer sepals strongly winged upon the keel: akene acutely triangular. — From the Atlantic States to the Upper Missouri, Colorado, and Washington.

ORDER 67. ELÆAGNACEÆ.

Shrubs, the foliage scurfy throughout with scarious silvery or brown scales, with regular flowers perfect or diœcious, the perianth herbaceous or colored within, its tube lined with a prominent disk bearing the stamens, enclosing the 1-celled ovary, and becoming pulpy or spongy without and bony within; fruit a membranous akene, closely covered by the drupe-like calyx-tube. Flowers solitary or variously clustered in the axils of the branchlets.

1. **Elæagnus.** Flowers perfect. Stamens 4. Leaves alternate.

2. **Shepherdia.** Flowers diœcious. Stamens 8. Leaves opposite.

1. ELÆAGNUS, L.

Calyx-limb cylindric-campanulate or tubular below, parted above into 4 deciduous lobes, colored within. Disk glandulose. Stamens adnate to the calyx and alternate with its lobes. Fruit drupe-like, with an oblong, 8-striate stone. — Leaves entire and petioled, and flowers axillary and pedicellate.

1. **E. argentea**, Pursh. A stoloniferous unarmed shrub, 6 to 12 feet high, the younger branches covered with ferruginous scales: leaves broad or narrowly elliptic, silvery-scurfy and more or less ferruginous: flowers numer-

¹ *P. Convolvulus*, L., is low twining or procumbent and minutely scabrous, leaves halberd-cordate acuminate, flowers few in axillary fascicles or small interrupted racemes on very short pedicels, outer sepals sharply keeled. — Introduced from Europe, very common in the Eastern States, and found in Colorado and Montana.

ous, deflexed, silvery without, pale yellow within, fragrant, the tube broadly oval, the limb funnelform: fruit globose-ovoid, dry and mealy, edible. — From Utah to the Upper Missouri and eastward to Minnesota and Canada.

2. SHEPHERDIA, Nutt. BUFFALO-BERRY.

Staminate perianth 4-parted, the lobes spreading. Stamens alternate with as many lobes of a thick disk; filaments free. Pistillate flowers with oblong-tubular perianth; limb 4-cleft, erect, the throat closed by the lobes of the disk. Fruit berry-like, with a smooth shining compressed seed. — Flowers small (the staminate larger), shortly pedicellate.

1. *S. argentea*, Nutt. Somewhat spiny shrub, 5 to 18 feet high: *leaves silvery on both sides, mostly oblong, obtuse, cuneate at base: fruit a smooth ovoid scarlet berry, acid and edible, nearly sessile.* — East of the Sierra Nevada to the Saskatchewan, and southward in the mountains to New Mexico.

2. *S. Canadensis*, Nutt. Shrub 3 to 6 feet high, *the branchlets, young leaves, yellowish flowers, etc., covered with rusty scales: leaves elliptical or ovate, nearly naked and green above, silvery downy as well as scurfy with rusty scales beneath: fruit yellowish-red, insipid.* — From the Columbia River eastward across the continent, and in the mountains southward to New Mexico.

ORDER 68. LORANTHACEÆ.

Evergreens, parasitic on shrubs or trees, dull yellowish-green or brownish, with dichotomous branches and swollen joints, the opposite thick and coriaceous exstipulate and entire leaves reduced to mostly connate scales: flowers diœcious, of 2 to 5 sepals coherent at base: anthers as many as the sepals and inserted upon them: ovary inferior, 1-celled: fruit a berry with glutinous endocarp. — Flowers small and inconspicuous, greenish.

1. **Phoradendron.** Flowers globose, mostly 3-lobed. Anthers 2-celled, opening by 2 pores or slits: pollen-grains smooth. Berry globose, pulpy and semi-transparent.
2. **Arceuthobium.** Flowers mostly compressed; the staminate usually 3-parted, the pistillate 2-toothed. Anthers a single orbicular cell, opening by a circular slit; pollen spinulose. Berry compressed, fleshy.

1. PHORADENDRON, Nutt. MISTLETOE.

Flowers immersed in the rachis of jointed spikes. — Parasitic on branches of various kinds of trees: spikes single or in pairs in the axils of opposite leaves, the lowest joint sterile, the others bearing solitary or several flowers on each side. Flowering in February or March, and maturing its fruit the next winter.

1. *P. juniperinum*, Engelm. Glabrous, stout, densely branched, 6 to 9 inches high: branches terete, the ultimate branchlets quadrangular: scales broadly triangular connate or distinct, ciliate: staminate spikes of a single

6 to 8-flowered joint: pistillate spikes 2-flowered: berry whitish or light red. — Pl. Fendl. 58. On different species of *Juniperus*. S. W. Colorado to New Mexico, Arizona, Nevada, and California.

2. ARCEUTHOBIMUM, Bieb.

Flowers axillary or terminal, solitary or several from the same axil. — Parasitic on Conifers, glabrous, with rectangular branches and connate scale like leaves: flowers often crowded into apparent spikes or panicles, opening in summer or autumn and maturing their fruit in the second autumn, when the berries suddenly and forcibly eject the glutinous seed to the distance of several yards.

* *Staminate flowers all (or nearly all) terminal on distinct peduncle-like joints, paniculate.*

1. **A. Americanum**, Nutt. Slender, dichotomously or verticillately much branched, greenish yellow: staminate plants sometimes 3 or 4 inches long, fertile plants much smaller. — On *Pinus contorta*. From Wyoming to Oregon and southward to Colorado and California.

* * *Staminate flowers axillary (with a terminal one), forming simple or compound spikes. Ours are greenish-brown, with the accessory branchlets of fruiting specimens mostly leaf-bearing.*

2. **A. divaricatum**, Engelm. Rather stout, 2 to 4 inches high, and a line in diameter at base, olive-green or pale brownish: branches spreading, often flexuous or recurved: staminate flowers few and scattered or in 3 to 7-flowered spikes, with ovate acute lobes. — Pl. Wheeler, 1874, 16. On *Pinus edulis* and *P. monophylla*, from New Mexico and S. Colorado to Arizona and S. Utah.

3. **A. robustum**, Engelm. Stouter and not so spreading: spikes much denser, the buds of the staminate flowers flat and appressed, and the 3-parted flowers with shorter and broader lobes. — On *Pinus ponderosa*. Arizona and northward in the Rocky Mountains.

ORDER 69. SANTALACEÆ.

Herbs or shrubs, usually root-parasitic, with angled or striate branches, entire alternate and mostly sessile leaves without stipules, and mostly perfect flowers with 3 to 5-cleft perianth adherent to the 1-celled 2 to 4-ovuled ovary, which becomes an indehiscent 1-seeded usually nut-like fruit; stamens 3 to 5, opposite the perianth lobes, at the edge of an epigynous often lobed disk; style 2 to 5-lobed.

1. COMANDRA, Nutt. BASTARD TOAD-FLAX.

The campanulate or urn-shaped perianth with a 5-lobed persistent limb. Disk with a free lobed margin. Stamens included: anthers attached by tufts of hairs to the base of the calyx-lobes. — Low herbaceous smooth perennials, with subterranean rootstocks: leaves glaucous, the lowest scale-like: flowers greenish white, in small terminal or axillary umbellate clusters.

1. **C. umbellata**, Nutt. Stems leafy, 6 to 15 inches high : *leaves oblong* : umbels few-flowered, corymbosely clustered at the summit of the stem : flowers on slender pedicels, the white oblong erect or slightly spreading lobes about equalling the green tube, which is continued conspicuously above the ovary : *fruit globular, 2 or 3 lines in diameter*. — In the Sierra Nevada of California northward to Washington and eastward across the continent.

2. **C. pallida**, A. DC. Differing from the last in its *narrower more glaucous and acuter leaves, which are linear to narrowly lanceolate* (or those upon the main stem oblong), all acute or somewhat cuspidate : *fruit ovoid, larger* (3 to 4 lines long), sessile or on short stout pedicels. — New Mexico and Colorado to Oregon.

ORDER 70. EUPHORBIACEÆ. (SPURGE FAMILY.)

Herbs (ours), with milky acrid juice, monœcious or diœcious commonly apetalous and often naked flowers, a free and usually 3-celled ovary with (in ours) one pendulous ovule in each cell, and maturing into a 3-celled elastically dehiscent capsule with crustaceous seeds. Stamens one to many. Styles or stigmas as many or twice as many as the cells of the ovary. Leaves mostly alternate and simple, often stipulate.

* Staminate and pistillate flowers both with a perianth, without an involucre.

+ Stamens erect in the bud.

1. **Tragia**. Petals none. Calyx 3 to 8-parted. Flowers in racemes, terminal or opposite the leaves, pistillate at the base. Stamens 2 or 3. Style 3-parted.

2. **Argythamnia**. Petals and sepals 5. Flowers in axillary spicate clusters, pistillate below. Stamens 5 to 15 in 1 to 3 whorls. Styles bifid.

+ + Stamens incurved in the bud.

3. **Croton**. Flowers in terminal spike-like racemes. Erect and gray-scurfy.

** Flowers all without perianth, included in a cup-shaped calyx-like involucre.

4. **Euphorbia**. Pistillate flower solitary, soon exserted : the staminate numerous, each of a single stamen.

1. TRAGIA, Plumier.

Staminate calyx 3 to 5-parted. Filaments short : anther-cells united. Pistillate calyx 3 to 8-parted, persistent. Pod 3-lobed, bristly, separating into three 2-valved carpels. — Erect or climbing plants, pubescent or hispid, sometimes stinging, with mostly alternate stipulate leaves : the sterile flowers above, the few fertile at the base, all with small bracts.

1. **T. nepetæfolia**, Müller, var. **ramosa**, Müller. Hirsute, erect, much branched, 6 to 8 inches high : stem slender, at length flagelliform-elongated, weak and somewhat turning : leaves triangular-ovate from a cordate base or oftener lanceolate, gradually acuminate. — Colorado and southward.

2. ARGYTHAMNIA, P. Browne.

Calyx valvate in the staminate flowers, imbricate in the pistillate. Petals alternate with the calyx-lobes and with the lobes of the glandular disk.

Filaments united into a central column. Seeds subglobose, roughened or reticulated, not carunculate. — Erect herbs or undershrubs, with purplish juice: leaves alternate, usually stipulate, entire (in ours).

1. **A. humilis**, Müll. Stem about one foot high, much branched, silky or strigose-pubescent, branches spreading: leaves narrowed at the base, spatulate or obovate-lanceolate or linear-lanceolate, acute, sparingly pubescent: raceme much shorter than the leaves, on very short peduncles. — S. Colorado and southward.

3. CROTON, L.

Staminate calyx 4 to 6-parted. Petals often present, but small or rudimentary, alternating with the glands of a central disk. Stamens 5 to many, on a hairy receptacle. Pistillate calyx usually 5-parted, but the petals mostly obsolete. Seeds smooth and shining, carunculate. — Herbs or shrubs, scurfy or stellately hairy or sometimes glandular: leaves alternate, entire or repand.

1. **C. Texensis**, Müll. Covered with a close canescent stellate pubescence, dichotomously branched or spreading, 1 to 2 feet high: leaves lance-ovate, oblong, or linear-lanceolate: diœcious; racemes of staminate flowers short: ovary stellate-tomentose; styles twice or thrice dichotomously 2-parted. — S. Colorado and southward.

4. EUPHORBIA, L.

Flowers monœcious, included in 4 to 5-lobed involucre, the lobes usually alternating with as many fleshy glands which are rounded or often petaloid-margined or crescent-shaped. — Mostly herbs: leaves opposite or alternate or the upper ones verticillate: involucre terminal or in the forks, the sterile flowers lining the base and each from the axil of a little bract, the fertile flower solitary in the middle of the involucre, soon protruded on a long pedicel.

A. *Glands of the involucre with petal-like, usually white or rose-colored, entire or toothed margins or appendages.*

§ 1. *Leaves all similar, opposite, on short petioles, small, oblique at base, furnished with awl-shaped or scaly and often fringed stipules: stems much branched, spreading or usually procumbent: involucre solitary in the forks of the branches or in terminal or lateral clusters, small, with 4 glands.*

* *Seeds smooth and even: leaves entire, glabrous.*

1. **E. petaloidea**, Engelm. Glabrous: stems procumbent or ascending: leaves attenuate to the scarcely oblique base, oblong-linear or linear, retuse or emarginate: involucre solitary, campanulate, lobes hairy beneath the glands within, the broadly campanulate appendages conspicuous; peduncles longer than petioles: seeds reddish, with rounded angles. — From Colorado to Nebraska and eastward to the Mississippi.

2. **E. flagelliformis**, Engelm. Distinguished from the last by the smaller involucre bearing very small and almost naked glands, often less than

four in number; the more numerous stamens (often 25) with much smaller anthers; and by the smaller, more angular and more pointed, grayish seeds.—Brandegee, Fl. S. W. Colorado, 243. S. W. Colorado to the Rio Grande.

* * *Seeds minutely roughened or transversely wrinkled, or pitted.*

+ *Leaves entire.*

3. **E. lata**, Engelm. *Canescent with appressed pubescence: stems from a woody rootstock, spreading, short, rigid; lower internodes longer than the leaves, uppermost very short: leaves triangular-ovate, abruptly attenuate at base, or oblong with revolute margins; stipules triangular-lanceolate: involucre axillary, solitary, campanulate, hairy, lobes elongated; glands ovate with a very narrow lobulate appendage: capsule hirsute: seed oblong, transversely wrinkled.*—S. E. Colorado and southward.

4. **E. Fendleri**, Torr. & Gray. *Glabrous, from a slender root-stock: stems delicately filiform, erect or decumbent: leaves ovate from a rounded base; stipules subulate, often lacinate at base: involucre terminal, solitary, turbinate, slightly bearded in the throat, lobes short; glands transversely oblong with a very narrow obsolete appendage: seed ovate, 4-angled, irregularly punctate.*—S. Colorado and southward.

5. **E. revoluta**, Engelm. *Glabrous: stem erect, filiform, naked below, much branched above the middle: leaves narrowly linear, revolute on the margins, attenuated below; stipules subulate, entire: involucre very small, uppermost in the forks of the branches and terminal, short-campanulate; glands purple, with a whitish or reddish oblong appendage: capsule glabrous: seed oblong, sharply 4-angled, sparingly and irregularly rugose.*—Colorado and southward.

+ + *Leaves serrate or serrulate: flowers in lateral leafy clusters.*

6. **E. stictospora**, Engelm. *Prostrate and pubescent: leaves rounded, subcordate, sharply serrate: racemes crowded, with very small and slender long-peduncled involucre: capsule sharp angled, pubescent: seeds slender, sharply 4-angled, rugose-dotted.*—Bot. Mex. Bound. 187. Abundant in New Mexico and extending into S. Colorado.

7. **E. serpyllifolia**, Pers. *Prostrate-spreading and glabrous: leaves obovate-oblong, narrowed at the very oblique base, sharply serrulate toward the apex: glands of the involucre with narrow somewhat toothed appendages: seeds acutely 4-angled, slightly cross-wrinkled and often pitted.*—From California and the Columbia River to the Saskatchewan, Iowa, and Texas.

8. **E. glyptosperma**, Engelm. *Erect-spreading and glabrous: leaves linear-oblong, mostly falcate, very unequal at base (semicordate), sharply serrulate: glands of the very small involucre with narrow crenulate appendages: seeds sharply 4-angled and with 5 or 6 sharp transverse wrinkles.*—From Illinois and Wisconsin to Colorado and the Columbia River.

9. **E. maculata**, L. *Prostrate and puberulent or hairy: leaves oblong-linear, very oblique at base, serrulate upwards, usually with a brown-red spot in the centre: glands of the small involucre minute, with narrow slightly crenate (usually red) appendages: seeds ovate, sharply 4-angled and with about 4 shallow grooves across the concave sides.*—Colorado, and common eastward.

§ 2. *Leaves opposite, on short petioles, equal at base, with stipular glands: stems dichotomously branched, erect: cymes terminal, involucre with 5 glands: seeds tuberculate.*

10. **E. hexagona**, Nutt. Somewhat hairy: stem a foot or more high; branches striate-angled: leaves linear-lanceolate, entire: involucre hairy without and within: glands with a green ovate-triangular appendage twice their length: capsule smooth: seeds ovate. — From Texas and Colorado to the Upper Missouri.

§ 3. *Uppermost or floral leaves with conspicuous white petal-like margins, whorled or opposite, the others scattered, equal at base, entire and sessile: involucre 5-lobed, collected in an umbel-like inflorescence.*

11. **E. marginata**, Pursh. Stem stout (2 to 3 feet high), erect, hairy: leaves ovate or oblong: umbel with 3 dichotomous rays: glands of the involucre with broad white appendages. — From Colorado to Kansas and Nebraska. Cultivated and run wild in the Eastern States.

B. *Glands of the involucre without petaloid appendages.*

§ 4. *Involucres in terminal clusters, 4 to 5-lobed, with few cup-shaped glands: seed without a caruncle: leaves dentate, all but the lowest opposite, and stipules glandular.*

12. **E. dentata**, Michx. Erect or ascending, hairy: leaves ovate, lanceolate, or linear, petioled, coarsely toothed, upper ones often paler at the base: involucre almost sessile, with 5 oblong dentate lobes, and one or more short-stalked glands: seeds ovate-globular, slightly tubercled. — S. Colorado (*Brun-degee*) and eastward to Illinois and Pennsylvania.

§ 5. *Involucres in a terminal dichotomous or commonly umbelliferous inflorescence, 4 or 5-lobed, with as many flat or convex entire or crescent-shaped glands: seeds mostly carunculate: glabrous, with entire or serrulate scattered (except the uppermost) leaves and no stipules.*

13. **E. obtusata**, Pursh. Erect: leaves oblong-spatulate, minutely serrulate, smooth, obtuse; upper ones cordate at base; floral ones ovate, dilated: umbel once or twice divided into 3 rays, then into 2: involucre with naked lobes and small stipitate glands: styles distinct and longer than the ovary, erect, 2-cleft to the middle: pod beset with long warts: seeds smooth and even. — S. Colorado, and from Illinois to Virginia.

14. **E. dictyosperma**, Fisch. & Meyer. Erect: leaves oblong- or ovate-spatulate, smooth, obtuse and obtusely serrate; upper ones cordate at base: umbels once or twice 3-forked, then 2-forked: involucre with nearly naked lobes and small almost sessile glands: styles shorter than the ovary, spreading or recurved: pod warty: seeds delicately reticulated. — From California and Oregon to Texas, Kentucky, and Nebraska.

15. **E. montana**, Engelm. Very glabrous and glaucous: stems leafy and ascending: leaves rather thick, entire, ovate, obtuse; floral ones orbiculate, triangular: umbels repeatedly dichotomous: involucre roughish within, with oblong-linear revetely lobes, and truncate, very shortly 2-horned glands: styles very short, bifid: pod smooth: seeds superficially pitted. — From the Upper Platte to New Mexico, Arizona, and southward.

ORDER 71. **CALLITRICHACEÆ.** (WATER-STARWORTS.)

Small slender aquatic herbs, with opposite entire leaves, no stipules and monœcious axillary flowers without perianth, but sometimes with 2 bracts; stamen 1, with slender filament and heart-shaped 4-celled anther; ovary 4-celled, with 2 styles; fruit 4-lobed, flattened and emarginate. Flowers mostly solitary, sometimes a male and female in the same axil

1. **CALLITRICHE, L.**

Characters given under the order.

1. **C. verna, L.** *Amphibious, with elongated stems and floating rosulate obovate often emarginate leaves, the submerged ones from spatulate to linear: bracts often exceeding the fruit, rarely wanting: styles erect or spreading, deciduous: fruit orbicular or obcordate or elliptical, of connate carpels.* — From California and Oregon to Montana and Wyoming, and eastward across the continent.

2. **C. autumnalis, L.** *Submersed, with numerous uniform linear one-nerved leaves, truncate or retuse at the apex: flowers without bracts: styles reflexed, caducous: fruit round, deeply notched, the margins thin or at length winged.* — From California northward, and thence eastward across the continent.

ORDER 72. **CERATOPHYLLACEÆ.** (HORNWORT FAMILY.)

Aquatic herbs, with whorled finely dissected leaves, and minute axillary and sessile monœcious flowers without floral envelopes, but with an 8 to 12-cleft involucre in place of a calyx — the fertile a simple 1-celled ovary.

1. **CERATOPHYLLUM, L.**

Sterile flowers of 12 to 24 stamens, with sessile anthers. Fruit an achene, beaked with a slender persistent style. — Submersed plants, in ponds or slow-flowing streams: the sessile leaves cut into thrice-forked threadlike divisions.

1. **C. demersum, L.** *Stems very slender, a foot or two long: leaves in numerous whorls of 6 to 8: akene elliptical, shortly stipitate, with a short spine or tubercle on each side near the base.* — California and northward, thence eastward across the continent.

ORDER 73. **URTICACEÆ.**

Plants generally with stipules, and monœcious or diœcious, or rarely perfect flowers, furnished with a regular calyx, free from the 1-celled ovary which forms a 1-seeded fruit; stamens as many as the lobes of the calyx and opposite them, or sometimes fewer.

SUBORDER I. **ULMACEÆ.** (ELM FAMILY.)

Flowers perfect or monœciously polygamous. Filaments straight or moderately incurved in the bud. Styles or stigmas 2. Fruit a samara or drupe. — Trees, with alternate leaves.

1. **Ulmus.** Flowers sometimes perfect. Ovary 2-ovuled. Fruit a samara. Anthers extrorse.
2. **Celtis.** Flowers polygamous. Ovary 1-ovuled. Fruit a drupe. Anthers introrse.

SUBORDER II. **URTICEÆ.** (NETTLE FAMILY.)

Flowers monœcious or diœcious. Filaments wrinkled and inflexed in the bud. Style or stigma simple. Ovary always 1-celled and 1-seeded, becoming an akene. — Herbs with a tough fibrous bark and opposite or alternate leaves.

- * Calyx in the fertile flowers of 2 to 5 separate or nearly separate sepals: plant beset with stinging bristles.
- 3. **Urtica.** Sepals 4 in both sterile and fertile flowers. Akene straight and erect, enclosed by the 2 inner and larger sepals. Stigma capitate-tufted. Leaves opposite.
- 4. **Laportea.** Sepals 5 in the sterile flowers, 4 in the fertile, or apparently only 2, the two exterior being minute. Akene very oblique and bent down, nearly naked. Stigma long and awl-shaped. Leaves alternate.
- ** Calyx of the fertile flowers tubular or cup-shaped, enclosing the akene. Plant wholly destitute of stinging bristles.
- 5. **Parietaria.** Flowers polygamous, in involucre-bracted clusters. Stigma tufted. Leaves alternate.

SUBORDER III. **CANNABINEÆ.** (HEMP FAMILY.)

Flowers diœcious; the sterile racemed or paniced; the fertile in clusters or catkins. Filaments short, not inflexed in the bud. Fertile calyx of one sepal, embracing the ovary. Stigmas 2, elongated. Ovary 1-celled, 1-ovuled, becoming a glandular akene. — Herbs with opposite lobed leaves and a fibrous inner bark.

6. **Humulus.** Fertile flowers in a short spike forming a membranaceous catkin in fruit. Anthers erect. Leaves 3 to 5-lobed.

1. **ULMUS, L.** **ELM.**

Calyx bell-shaped, 4 to 9-cleft. Stamens 4 to 9, with long slender filaments. Ovary 2-celled. Fruit winged all around. — Flowers polygamous, purplish or yellowish, in lateral clusters, preceding the leaves, which are strongly straight-veined, short-petioled, and oblique or unequally somewhat heart-shaped at base.

1. **U. Americana, (L.) Willd.** Buds and branchlets glabrous: branches not corky: leaves obovate-oblong or oval, abruptly pointed, sharply and often doubly serrate, soft pubescent beneath or soon glabrous, smooth above or nearly so: flowers on slender drooping peduncles which are jointed above the middle, in close fascicles: fruit glabrous except the margins, its sharp points

incurved and closing the notch. — In the Atlantic States, and extending within our boundary through Minnesota. Known as “American” or “White Elm.”

2. *CELTIS*, Tourn. HACKBERRY.

Calyx 5 to 6-parted. Stamens 5 to 6. Ovary 1-celled. Fruit globular. — Leaves pointed, petioled: flowers greenish, axillary, the fertile solitary or in pairs, peduncled, appearing with the leaves; the lower usually staminate only, in little fascicles or racemose along the base of the branches of the season.

1. *C. occidentalis*, L. Leaves reticulated, ovate, cordate-ovate and ovate-lanceolate, taper-pointed, sharply serrate, sometimes sparingly so or only towards the apex, scabrous but mostly glabrous above, usually soft-pubescent beneath, at least when young: fruit reddish or yellowish, becoming dark purple. — From Colorado to Wisconsin and eastward. A small or middle sized tree with the aspect of an elm.

3. *URTICA*, Tourn. NETTLE.

Flowers clustered, the clusters mostly in racemes, spikes, or loose heads. Stamens in the fertile flowers inserted around the cup-shaped rudiment of a pistil. — Flowers greenish. Ours are perennials with flower clusters in panicles or paniced spikes.¹

1. *U. gracilis*, Ait. *Sparingly bristly, slender: leaves ovate-lanceolate, serrate, 3 to 5-nerved from the rounded or scarcely heart-shaped base, almost glabrous, the elongated slender petioles sparingly bristly: spikes slender and loosely paniced.* — Colorado and northward, thence eastward across the continent.

2. *U. Breweri*, Watson. *Tall and stout, grayish with a short somewhat hispid pubescence, or nearly glabrous, and with scattered bristles: leaves thin, finely pubescent, soon glabrate or roughish above, ovate to oblong-lanceolate, rounded or slightly cordate at base, coarsely serrate, on slender petioles: flowers in short open panicles scarcely exceeding the petioles.* — Proc. Amer. Acad. x. 348. Ranging from S. California to S. Colorado and Texas.

3. *U. holosericea*, Nutt. *Tall and stout, more or less bristly, finely and densely tomentose especially on the lower side of the leaves: leaves thick, oblong- to ovate-lanceolate, rounded at base, on short stout petioles: staminate flowers in loose slender diffuse panicles nearly equalling the leaves; pistillate panicles denser and shorter.* — *U. dioica*, var. *occidentalis*, Watson, Bot. King Exped. Abundant in the Wasatch and westward throughout California.

4. *LAPORTEA*, Gaudichaud. WOOD-NETTLE.

Flowers clustered in loose cymes; the upper widely spreading and chiefly or entirely fertile; the lower mostly sterile. — Herbs with large alternate serrate leaves, and axillary stipules.

¹ *U. dioica*, L., is very bristly and stinging, with leaves ovate, heart-shaped, very deeply serrate, downy underneath, and the spikes much branched. — Introduced into Colorado and elsewhere from the East, where it has come from Europe.

1. **L. Canadensis**, Gaudichaud. Leaves ovate, pointed, strongly feather-veined, long-petioled; stipule single, 2-cleft. — Throughout the Atlantic States, and coming within our borders at the northwest.

5. PARIETARIA, Tourn. PELLITORY.

The staminate, pistillate, and perfect flowers intermixed in the same involucre-bracted cymose axillary clusters. — Diffuse or tufted herbs, with entire 3-ribbed leaves and no stipules.

1. **P. Pennsylvanica**, Muhl. Low, simple or sparingly branched, minutely downy: leaves oblong-lanceolate, thin, veiny, roughish with opaque dots: flowers shorter than the leaves of the involucre. — From Colorado to Nevada and eastward across the continent.

6. HUMULUS, L. HOP.

Sterile flowers with 5 sepals and 5 erect stamens. Fertile flowers in short spikes with leafy imbricated bracts, each 2-flowered. A keene invested with the enlarged scale-like calyx. — Twining rough perennials, with stems almost prickly downwards, mostly opposite heart-shaped and palmately 3 to 7-lobed leaves.

1. **H. Lupulus**, L. Leaves commonly longer than the petioles: the fruiting calyx, a keene, etc., sprinkled with yellow resinous grains, giving the bitterness and aroma of the hop. — In the mountains from New Mexico to British America and eastward across the continent.

ORDER 74. CUPULIFERÆ. (OAK FAMILY.)

Trees or shrubs, with alternate and simple straight-veined leaves, deciduous stipules, and monœcious flowers, both kinds of flowers in catkins, or the fertile solitary, clustered, or spiked, the 1-celled, 1-seeded nut with or without an involucre.

Tribe I. Both kinds of flowers in scaly catkins, 2 or 3 under each bract, and no involucre to the naked often winged small nut. — **BETULÆ.**

1. **Betula**. Stamens 2, with bifurcate filaments and separate anther-cells. Bracts 3-lobed, becoming coriaceous and caducous. Nutlet broadly winged.
2. **Alnus**. Stamens 4: anther-cells contiguous. Bracts entire, becoming woody, persistent. Nutlet not winged.

Tribe II. Sterile flowers destitute of a true calyx, consisting of several stamens included under and more or less adnate to a bract: filaments short; anthers 1-celled. Fertile flowers in a scaly bud or catkin, two under each fertile bract, each with one or more bractlets, which form a foliaceous involucre to the nut. — **CORYLÆ.**

3. **Corylus**. Bract of staminate flower furnished with a pair of bractlets inside. Involucre leafy-coriaceous, enclosing the large bony nut.

Tribe III. Sterile flowers with a distinct 4 to 7-lobed calyx, including 3 to 20 stamens: filaments exserted; anthers 2-celled. Fertile flowers one or few enclosed in a cupule consisting of bracts variously consolidated. — **QUERCINÆ.**

4. **Quercus**. Sterile flowers in slender catkins. Cupule 1-flowered, scaly and entire; nut hard and terete.

1. **BETULA**, Tourn. BIRCH.

Sterile flowers 3, and bractlets 2, under each shield-shaped scale or bract of the catkins, consisting each of a calyx of one scale bearing 2 two-parted filaments. Fertile flowers without bractlets or calyx. — Outer bark usually separable in sheets, that of the branchlets dotted. Twigs and leaves often spicy-aromatic.

1. **B. occidentalis**, Hook. *Becoming 10 or 20 feet high, with close dark-colored bark (at length light brown); branches more or less resinous-dotted at the extremities: leaves thin, broadly ovate, acute, truncate or rounded or somewhat cuneate at base, with short glandular-tipped serratures and often obscurely lobed, somewhat resinous above, smooth or slightly appressed-villous beneath: the divaricately 3-lobed bracts pubescent ciliate: wings of the nutlet as broad as the body or broader.* — From California to Washington and the Saskatchewan, and in the Rocky Mountains to New Mexico. Sometimes called "Black Birch."

2. **B. glandulosa**, Michx. *A low bush, 4 to 6 feet high or less, the dark-colored branches usually more or less resinous-glandular: leaves small, obovate to oblong-obovate, mostly cuneate at base, rounded and crenate above, smooth and often resinous-coated: the deeply 3-lobed bracts slightly ciliate: seed orbicular-winged.* — From California to Sitka, and eastward through British America to the Atlantic, and southward in the mountains to New Mexico.

2. **ALNUS**, Tourn. ALDER.

Sterile flowers 3, and bractlets 4 or 5 under each short-stalked shield-shaped scale, consisting each of a 3 to 5-parted calyx and as many stamens, with the filaments short and simple. Fertile flowers with a calyx of 4 little scales adherent to the scales or bracts of the catkin.

§ 1. *Flowers developed in spring with the leaves; the sterile from catkins which have remained naked over winter; while the fertile have been enclosed in a scaly bud: fruit with a conspicuous thin wing.*

1. **A. viridis**, DC. Shrub 3 to 8 feet high: leaves round-oval, ovate, or slightly heart-shaped, glutinous and smooth or softly downy underneath, serrate with very sharp and closely set teeth, on young shoots often cut-toothed: fertile catkins slender-stalked, clustered, ovoid. — Mountains of Colorado and northward into British America, and thence eastward to N. New York and New England.

§ 2. *Flowers developed in earliest spring, before the leaves, from mostly clustered catkins which (both sorts) were formed the foregoing summer and have remained naked over winter: fruit wingless or with a narrow coriaceous margin.*

2. **A. incana**, Willd. Shrub or small tree 8 to 20 feet high: leaves broadly oval or ovate, rounded at the base, sharply serrate, often coarsely toothed, whitened and mostly downy underneath: fruit orbicular. — From Colorado northward and thence eastward.

Var. **virescens**, Watson. Leaves acutely double-toothed, light green and glabrous on both sides or sparingly pubescent: nutlets round-obovate, thinly

margined. — Bot. Calif. ii. 81. Ranges eastward with the species, but extends westward to the S. Sierra Nevada and Oregon.

3. CORYLUS, Tourn. HAZEL-NUT.

Sterile flowers in drooping cylindrical catkins. — Shrubs with doubly-toothed leaves, flowering in early spring: sterile catkins single or fascicled from scaly buds of the axils of the preceding year, the fertile terminating early leafy shoots.

1. *C. rostrata*, Ait. Shrub 2 to 5 feet high: leaves ovate or ovate-oblong, somewhat heart-shaped, pointed: involucre of united bracts, much prolonged above the ovoid nut into a narrow tubular beak, densely bristly. — From Colorado to Washington, thence northward and eastward to the Alleghanies.

4. QUERCUS, L. OAK.

Sterile flowers in naked catkins. Fertile flowers scattered or somewhat clustered. — Flowers greenish or yellowish: sterile catkins single or often several from the same lateral scaly bud: flowering in the spring and shedding the nuts in the fall. — Our two species are "White Oaks," being annual-fruited and having sweet kernels.

1. *Q. macrocarpa*, Michx. Leaves obovate or oblong, lyrate-pinnatifid or deeply sinuate-lobed, or nearly parted, downy or pale beneath; the lobes sparingly and obtusely toothed, or the smaller ones entire: *cup deep, conspicuously imbricated with hard and thick-pointed scales, the upper ones awned, so as usually to make a mossy fringed border: acorn half immersed in or entirely enclosed by the cup.* — Throughout the Atlantic States and coming within our range at its northeastern limit. North of the Missouri River a low scrubby form is found, which has been called var. *depressa*, Engelm., having also smaller leaves and much smaller acorns than the species.

2. *Q. undulata*, Torr. Leaves from lyrate to nearly entire, always downy below: the sweet and edible acorns oval, oblong, or sometimes elongated: the subhemispherical, sessile, short- or sometimes long-peduncled cup varies from scaly to very knobby. — Ann. Lyc. N. Y. ii. 248, t. 4; Engelm. in Trans. St. Louis Acad. iii. 382, 392. An exceedingly variable species, embracing, as now understood, all the Rocky Mountain forms. These forms can be arranged in two groups as follows: —

* *Leaves larger, strongly lobed, darker green, and decidedly deciduous: calyx-lobes narrower, ciliate: acorns often thicker and shorter.* — From W. Texas through Colorado to Utah and Arizona.

Var. *Gambelii*, Engelm. The large leaf with broader emarginate or even lobed divisions. — *Q. Gambelii*, Nutt.

Var. *Gunnisoni*, Engelm. Lobes of the leaf narrow and entire. — *Q. alba*, var. *Gunnisoni*, Torr.

Var. *breviloba*, Engelm. Leaves sinuate or broad- and short-lobed. — *Q. obtusiloba*, var. *breviloba*, Torr.

Var. *Jamesii*, Engelm. Like var. *Gunnisoni*, but the smaller and more rigid leaves with acute lobes.

* * *Leaves smaller, paler, more rigid, mostly spinous-dentate, and (at least southward) more or less persistent: calyx-lobes broader and woolly: acorns often slender and longer.* — Ranging farther north and east than the other group.

Var. **Wrightii**, Engelm. Leaves small (an inch long or less), sinuate-dentate, the teeth very rigid and pungent. — The *Q. Emoryi* of Fl. Colorado, with which Arizona species it has been constantly confounded.

Var. **grandifolia**, Engelm. Leaves very large (3 to 5 inches long), nearly entire or undulate: peduncles very long. — Upon the Upper Arkansas (*Brandegee*) and Arizona.

ORDER 75. SALICINÆ. (WILLOW FAMILY.)

Diœcious trees or shrubs, with both kinds of flowers in catkins, one under each bract, entirely destitute of floral envelopes; the fruit a 1-celled and 2-valved pod, with numerous seeds furnished with long silky down. — Leaves alternate, undivided.

1. **Salix**. Bracts entire. Flowers with small glands; disks none. Stamens few. Stigmas short. Buds with a single scale.
2. **Populus**. Bracts lacerate. Flowers with a broad or cup-shaped disk. Stamens numerous. Stigmas elongated. Buds scaly.

1. SALIX, Tourn. WILLOW. OSIER. (By M. S. BEBB, Esq.)

Aments preceding or accompanying the leaves. Filaments filiform, free or more or less connate. Ovary and capsule more or less conical. — Trees, shrubs, or undershrubs, mostly confined to the neighborhood of water: leaves mostly long and pointed, feather-veined.

§ 1. *Aments on short lateral leafy branchlets: scales yellowish, falling before the capsules mature: filaments hairy below: shrubs and small trees of the lowlands.*

* *Stamens 3 to 5: capsules glabrous: leaves lanceolate, serrate.*

1. **S. amygdaloides**, Anders. Leaves lanceolate or ovate-lanceolate, 2 to 4 inches long, $\frac{1}{2}$ to 1 inch wide, attenuate-cuspidate, paler or glaucous beneath, closely and sharply serrate; petioles slender eglandular; stipules minute and very early deciduous: staminate aments elongated, slenderly-cylindrical, 2 to 3 inches long, subflexuose, the flowers somewhat remotely and subverticillately arranged on the slender rhachis; fertile becoming very loose in fruit, 3 to 4 inches long: scales in male aments ovate, villous with crisp hairs, in the female narrower, smoother, and fugaceous: capsules lanceolate, on slender pedicels; style very short or obsolete, stigmas notched. — A small tree, growing on the banks of streams, from New York and Missouri west to Oregon. The nearly allied *S. nigra*, so common between the Gulf of Mexico and the Great Lakes, has not been found within our limits.

2. **S. lasiandra**, Benth., var. **Fendleriana**, Bebb. Leaves lanceolate, tapering to a very long attenuate point, coriaceous, scarcely paler beneath,

closely glandular-serrate; stipules small, roundish; *petioles glandular at the tip: staminate aments densely flowered, oblong-cylindrical, 1 to 2 inches long, obtuse; fertile rather shorter, erect or spreading, in fruit thick; scales dentate, hairy at base, in the female ament almost glabrous: stamens 5 or more: capsules tapering from an ovate base: style short; stigmas bifid.*—Banks of mountain streams, frequent. Scarcely distinguished from *S. lucida* of the Eastern States by the narrower and less glossy leaves.

* * *Stamens 2: capsules tomentose or glabrous: leaves linear, remotely mucronate-dentate.*

3. **S. longifolia**, Muhl. Leaves varying from linear to lanceolate, long acuminate, tapering at base, sessile or nearly so, 2 to 4 inches long, 1 to 6 lines (usually 2 to 3 lines) wide, margin remotely denticulate with projecting teeth or sometimes entire; stipules very early deciduous: aments linear-cylindrical, often clustered at the extremity of the branchlets: scales villous, dentate, subdeciduous: capsules oblong-conical, obtuse, shortly pedicelled, tomentose or glabrous: stigmas large, sessile. — From Maine and Maryland across the continent to Oregon and California. Exceedingly variable in foliage, flowers, and fruit. A shrub (within our limits) rooting extensively in alluvial deposits and forming dense clumps.

§ 2. *Aments lateral or terminal with or without bracts: scales persistent, usually darker at the tip: stamens 2; filaments glabrous.*

* *Capsules glabrous.*

4. **S. cordata**, Muhl. *Leaves linear- or oblong-lanceolate, acuminate, glandular-serrate, glabrous (usually more or less silky when young); those of vigorous barren shoots broadly-lanceolate, rounded or subcordate at base, 3 to 4 inches long, 1 to 1½ inches wide, rigid, paler and reticulate-veined beneath, coarsely serrate conspicuous stipules ovate or reniform; those of depauperate growths linear-lanceolate, taper-pointed at both ends, 2 inches long by ¼ inch wide, very finely and closely serrate, scarcely paler beneath, stipules minute: aments more or less bracted, cylindrical, 1 to 3 inches long in fruit: scales dark at the tip, clothed with long white hairs: capsule lanceolate, glabrous, green or reddish, long pedicelled: style medium; stigmas notched.*

Var. **Mackenziana**, Hook. Leaves obovate-lanceolate, narrowed at base, subentire; stipules small: aments shortly peduncled; pedicels long and slender, much exceeding the small, sparsely villous tawny scale.

Var. **vestita**, Anders. Recent twigs tomentose; young leaves silky: aments thick, closely sessile, preceding the leaves: scales clothed with long silky hairs.

Northern States clear across the continent and northward to the Arctic coast. The var. *vestita*, growing on the banks of the Missouri and Yellowstone Rivers, *L. F. Ward*, known as "Diamond Willow" from the peculiar arrest of wood-growth at the base of the atrophied twigs, is said to afford very durable timber. It is altogether incredible, however, that any form of *S. cordata* ever attains tree-like size.

5. **S. Novæ-Angliæ**, Anders. *Leaves obovate-oblong or oval, somewhat obtuse, closely crenate, green and glabrous both sides, young drying black, adult rigid, striate-nerved, shining; stipules small or none: aments short, oval-oblong,*

at first wrapped in the leaves of the short peduncle: scales obovate-roundish, apex black, villous with white hairs: capsules conic-rostrate glabrous, green or reddish, short-pedicelled: style medium; stigmas thick, entire, erect.

Var. **pseudo-myrsinites**. Small shrub 1 to 3 feet high, divaricately branched: leaves $1\frac{1}{2}$ inches long, $\frac{1}{2}$ inch wide, short petioled, *membranaceous*: *prominently nerved* aments leafy-bracted, $1\frac{1}{2}$ inches long.

Var. **pseudo-cordata**, Anders. By no means a tall shrub, branches upright: leaves oval-oblong, $1\frac{1}{2}$ inches long, $\frac{1}{2}$ inch wide, scarcely narrower below the middle, roundish at base, apex produced, rather acute, margin minutely serrulate: aments about an inch long.

Rocky Mountains of Colorado and Montana (valley of Nevada Creek, *Canby*), and northward to the Saskatchewan and Mackenzie Rivers.

6. **S. irrorata**, Anders. *Leaves linear-lanceolate*, 3 to 4 inches long, $\frac{1}{2}$ inch or less wide, very smooth, somewhat coriaceous, bright green and shining above except the yellowish midrib, paler or *often intensely glaucous beneath, remotely undulate-serrate*; petioles $\frac{1}{4}$ inch long; buds large, roundish; *stipules evanescent*: aments all appearing before the leaves, an inch long, crowded on the branches, sessile, scarcely bracted, *very densely flowered*; males oblong, golden-yellow, females erect or spreading, at length 1 to $1\frac{1}{2}$ inches long: scales dark, obtuse, villous: capsules ovate-conical, smooth, green, scarcely pedicelled: style medium; stigmas very short, entire or bifid. — Shrub 6 to 8 feet high, with upright branches. One-year-old twigs often covered with a beautiful glaucous bloom, which is easily rubbed off; not present on vigorous young shoots. Mountains near Golden, *Greene*; Maniton, *Brandegee*, *Jones*: Empire City, *Engelmann*. Only the very young leaves (an inch long) accompanying the flowers and fruit of Fendler's No. 812 were known to Professor Andersson.

7. **S. monticola**, Bebb. *Leaves oblong-lanceolate, the earliest obovate*, acute, 3 to 6 inches long, 1 to $1\frac{3}{4}$ inches wide, glabrous, rigid and glaucous beneath or thin and pale beneath, unevenly crenate or serrulate; *stipules large*, semicordate, acute; *buds large, ovate and beaked at the tip*: aments thick, densely flowered, sessile; males closely so; females with a few broad bracts at base, when in flower about an inch long, lengthening in fruit to $1\frac{1}{2}$ or 2 inches: scales oval, obtuse, clothed with long yellowish-white silky hairs: capsules ovate-conical, glabrous, sessile or nearly so: style elongated; stigmas erect, bifid or entire. — Marshy places along streams, mountains of Colorado: Golden, *Greene*; Georgetown, *Patterson*; Empire City, *Engelmann*. Also collected in fragmentary specimens, mostly old fruiting aments, by Hall and many other subsequent explorers: probably common. A densely caespitose shrub, 8 to 12 feet high, stem 1 to 2 inches in diameter. The broad, irregularly-toothed leaves (especially when rigid and glaucous beneath) bear a remarkable resemblance to those of *S. discolor*: a resemblance heightened by the conspicuous stipules on vigorous shoots; but the aments are very different. Allied to the foregoing and more nearly representing the European *S. daphnoides*, *S. irrorata* being the equivalent as it were of *S. acutifolia*.

* * Capsules tomentose (rarely glabrate in 12 and 13).

← Pedicels slender, style obsolete or none.

8. **S. flavescens**, Nutt. *Leaves obovate or oblanceolate, acute or the lower obtuse, wedge-shaped at base*, 2 to 3 inches long, 1 to $1\frac{1}{2}$ inches wide,

downy but very soon glabrate and dull green above, glaucous and rufous pubescent beneath or often when young clothed with a lustrous silky tomentum; margin entire or irregularly subserrate; stipules small, denticulate, fugaceous: *aments* oblong, densely flowered, *appearing before the leaves*, the males closely sessile, an inch long, the females on distinct peduncles, rarely with leafy bracts, in fruit 2 inches long or more: *scales* blackish, obovate, very silky: capsules white-tomentose, 3 to 4 lines long, tapering into a long beak, the slender pedicels about equalling the scales: styles obsolete; stigmas long, entire or deeply parted, the linear lobes inflexed. — A shrub, 4 to 5 feet high, alt. 6,500 feet. The geographical equivalent of the Eastern *S. discolor*, and represented on the western coast by the form known as *S. Scouleriana*.

9. **S. rostrata**, Richardson. Leaves varying from obovate to lanceolate, 1 to 3 inches long, acute or acuminate, thin at first, becoming rigid, serrate or nearly entire, downy or smooth above, glaucous, reticulate-veined and tomentose beneath; stipules usually small and deciduous: *aments* bracteate, *appearing with the leaves*; male sessile, rather short, densely flowered; *female becoming very loose in fruit*: capsules tomentose, tapering from near the base into a very long slender beak; *pedicels thread-like, conspicuously exceeding the pale, rosily-tipped, linear, thinly-villous scales*: style scarcely any; lobes of the stigma entire or deeply parted. — Does not spread from the root, forming a clump, but has rather the habit of a small bushy tree. A reduced form, divaricately much branched and the slender twigs thickly set with small, oblanceolate, mostly entire leaves, is common in the mountains. New England to Vancouver Island and northward to the Saskatchewan.

S. MACROCARPA, Nutt. (*S. Geyeriana*, And.), collected by Geyer on the Cœur d'Alene River in Northern Idaho, is likely to occur within our limits.

+ + *Pedicels short or none.*

+ + *Styles distinct.*

10. **S. chlorophylla**, Anders. Leaves lanceolate or oblong-obovate, quite entire, bright green above, glaucous beneath; stipules none: *aments short, closely sessile, naked at base, cylindrical, remarkably compact*: scales very dark: capsules sessile, ovate-oblong, obtuse, densely ashy-tomentose, style elongated, entire; stigmas entire. — A straggling bush, 1½ to 6 feet high, at 11,000 feet alt. One-year-old twigs shining chestnut, sometimes covered with a glaucous bloom: buds large, dark-colored: young leaves often silky. Cascade, Wasatch and Rocky Mountains; northward to the Saskatchewan.

11. **S. candida**, Willd. Leaves narrowly lanceolate, subcoriaceous, 2 to 4 inches long, ½ to ¾ inch wide, acute or the lowest obtuse, tapering at base into a short petiole, upper surface downy, becoming nearly glabrous when old, *under surface covered with a dense snow-white tomentum*; margin obscurely crenulate, *revolute*: aments subsessile, erect, cylindrical, when in flower about an inch long, anthers red, when in fruit lengthening to 1½ or 2 inches: scales obovate, clothed with long white hairs: capsule ovate-conic, *densely white-woolly*; pedicel about twice the length of the elongated, dark-colored nectary: style elongated, dark red; stigmas short, spreading, notched. — Bogs, foothills of the Rocky Mountains; rare. Near Cutbank Creek, Montana, *Cutby*; Colorado, *Hall*. Shrub 2 to 5 feet high: young shoots white-woolly, older shining red.

12. *S. glauca*, L., var. *villosa*, Anders. *Leaves oblanceolate, acute, attenuate at base, entire, 2 to 4 inches long, varying from soft villous to scarcely pilose when young, at length glabrate and rigid, more or less glaucous beneath; stipules lanceolate: aments short-peduncled, cylindrical, the fertile when mature sometimes very large, 2 to 3 inches long: scales oblong-obovate, rather acute, brownish: capsules lanceolate-acuminate, tomentose, at length subglabrate: pedicels equalling the nectary: style produced, entire or deeply bifid; stigmas entire or bifid.* — A diffuse shrub, 3 to 7 feet high, with short and stout branches, differing from typical *S. glauca* only in the less woolly and more pointed capsules and the usually entire styles. Low meadows, foot-hills of the mountains.

13. *S. desertorum*, Richards. *Leaves elliptical-oblanceolate, rigid, more or less whitish-tomentose beneath, the yellow midrib prominent: aments very short, subglobose or oblong, densely flowered: scales pale rose-color, densely white-villous: capsules ovate-conical, white-woolly, sessile: style short; stigmas bifid.*

Var. ? *Wolfii*. *Leaves at length smooth, scarcely paler beneath, with a tendency to blacken in drying: scales very dark, sparingly villous: capsules reddish, glabrate: style entire; stigmas notched.* — *S. Wolfii*, Bebb, Bot. Wheeler Exped. 241.

A low, 1 to 2 feet high, scraggy shrub, growing in clumps on alpine slopes far above the timber line. The leaves scarcely exceed an inch in length by 2 or 3 lines in width, the small, roundish compact aments very numerous, less than half an inch long, on short peduncles which are invested with two or three narrow leaf-like bracts often exceeding the ament in length. This is the typical form, *Drummond*, n. 657; *Hall & Harbour*, n. 523. Toward the foot-hills occur "varieties which have a very different aspect, with much larger, more woolly leaves, and longer and looser catkins," (Hooker,) presenting a manifest transition into *S. glauca-villosa*.

14. *S. arctica*, R. Br., var. *petræa*, Anders. *Leaves obovate, obtuse or lanceolate and tapering somewhat equally to the base and apex, an inch long, $\frac{1}{2}$ to $\frac{1}{2}$ inch wide, entire, green on both sides, slightly paler and prominently nerved beneath: aments terminal, erect, at length thick and densely flowered, 1 to 2 inches long: scales dark, thinly pilose: capsules ovate-conical, 2 to 3 lines long, tomentose, subsessile, the nectary rather exceeding the base of the capsule: style elongated, slender, entire; stigmas bifid, divaricate.* — Far above the timber line in little patches among the rocks, frequently blooming close to snow-banks. A very small creeping shrub, the half-buried horizontal branches sending up short few leaved twigs, which, with the conspicuous aments, rise only 2 to 3 inches above the surface. Colorado, California, and northward in other forms to the limit of vegetation.

++ ++ *Styles none: alpine shrubs with orbicular, reticulate-veined leaves.*

15. *S. vestita*, Pursh. *Leaves elliptical or oblong-ovate, obtuse, rounded at base, 1 to 2 inches long, obscurely crenulate, strongly reticulate on both surfaces, green above, glaucous beneath, and beautifully clothed with silky hairs, especially along the prominent midrib and excurrent veins; petioles short, about the length of the large, obtuse buds: aments on short villous peduncles opposite the last of 2 or 3 leaves on the branch, elongate-cylindrical,*

densely flowered, the males more slender: scales short, broad-ovate, silky: capsules ovate-conical, sessile, tomentose: style none, lobes of the stigmas bifid. — A procumbent shrub rising 2 to 3 feet above the rocks or boulders over which it spreads, making a dense mass 4 to 10 feet in diameter. Old Marias Pass, Montana, alt. 6 to 8,000 feet, *Sargent & Canby*. Also in Canada and Labrador.

16. **S. reticulata**, L. *Leaves* obovate or elliptic, $\frac{1}{2}$ to 1 inch long, rounded at base or mostly subattenuate into a long and slender petiole, quite entire, *glabrous*, green above, glaucous beneath, strongly reticulated, stipules none: aments $\frac{1}{2}$ to 1 inch long on slender peduncles at the ends of the short branches, opposite to the last leaf: scales obovate, purplish or yellow: capsule ovate, tomentose, sessile, nectary "a lacinate cup surrounding the base of the capsule": style very short or none; stigmas 2-cleft, brown, spreading. — A dwarf shrub of high alpine regions, with tortuous, buried stems, the leafy tips and flowers rising a few inches above the surface. Rocky Mountains and northward to the Arctic coast. Our plant is smaller than the European type, with narrower and thinner leaves, less wrinkled above and fewer-flowered aments. Extreme forms, in which the leaves are scarcely more than 2 to 3 lines in length and the aments reduced to 5 to 7 flowers, are designated var. *nivalis*, Hook. sp.

2. POPULUS, Tourn. POPLAR. COTTONWOOD. ASPEN.

Trees with broad and more* or less heart-shaped or ovate-toothed leaves, and mostly angular branches: buds scaly, covered with a resinous varnish: catkins long and drooping, appearing before the leaves.

1. **P. tremuloides**, Michx. Tree 20 to 50 feet high, with smooth greenish-white bark; *branches not angled: leaves roundish-heart-shaped*, with a short sharp point, and *small somewhat regular teeth, smooth on both sides, with downy margins: scales cut into 3 to 4 deep linear divisions, fringed with long hairs*. — From California eastward across the continent, and northward to the Arctic Ocean; in the Rocky Mountains as far south as New Mexico. The "Quaking Asp." The petiole is long, slender, and laterally compressed.

2. **P. angulata**, Ait. A large tree, 80 feet high or upward; *branches acutely angular or winged: leaves broadly deltoid or heart-ovate, smooth, crenate-serrate*, or with obtuse cartilaginous teeth. — Extending from the Atlantic States into our northeastern border, and abundant along the Platte. "Cottonwood."

3. **P. balsamifera**, L., var. *candicans*, Gray. A tall tree; *branches round: leaves more or less heart-shaped, pointed, serrate, whitish and reticulate-reined beneath: petioles commonly hairy: scales dilated, slightly hairy: the large buds varnished with copious fragrant resinous matter*. — From Colorado northward and eastward to Lake Superior and New England. Commonly called "Cottonwood."

4. **P. angustifolia**, James. *Branches terete, glabrous: leaves ovate-lanceolate, attenuate at base, acute, glabrous, crenate-serrate*. — *P. balsamifera*, var. *angustifolia*, Watson. From New Mexico and Colorado to California and Washington.

SUBCLASS II. MONOCOTYLEDONOUS or ENDOGENOUS PLANTS.

Embryo with one cotyledon. Leaves mostly parallel-veined, alternate, entire, and sheathing at base. Flowers usually in threes.

ORDER 76. ORCHIDACEÆ. (ORCHIS FAMILY.)

Herbs, distinguished by their perfect irregular flowers, with 6-merous perianth adnate to a 1-celled ovary, with very numerous minute ovules on 3 parietal placentæ, and with one or two gynandrous stamens, the pollen cohering in masses. Perianth of 6 divisions in 2 sets; the 3 outer, or sepals, mostly petal-like and resembling the 3 inner: one of the inner set is variously modified into what is called a *labellum* or *lip*, the other two alone being called petals. Before the lip, in the axis of the flower, is the *column*, composed of a single stamen (more in *Cypripedium*) variously coherent with or borne on the style or thick fleshy stigma; the anther 2-celled, each cell containing one or more masses of pollen, *pollinia*. Stigma a broad glutinous surface (except in *Cypripedium*). — Perennials, often tuberous, sometimes parasitic, with leaves mostly alternate. Flowers showy and singular in shape, arranged for cross-fertilization by means of insects.

Tribe I. Anther one, terminal and resting like a lid upon the column, deciduous; pollen-masses 4, smooth and waxy; leafless, except perhaps a single radical leaf: flowers pedicellate.

1. **Calypso.** Scape 1-flowered, from a solid bulb. Lip saccate. Column broadly-winged. Pollen-masses sessile on a large square membranaceous gland.
2. **Corallorhiza.** Flowers racemose, spurred or gibbous at base. Roots branched, coral-line. Lip expanded or concave, crested. Column semiterete. Pollen-masses sessile on a short oblong gland.
3. **Aplectrum.** Flowers racemose, not spurred nor gibbous. Lip expanded, deeply 3-lobed. Column nearly terete. Pollen-masses in distinct pairs, without glands. Rootstocks bearing a solid bulb and a single large green leaf.

Tribe II. Anther one, connate with the column and persistent upon its face just above the stigma; pollen-masses 2, of coarse grains united by an elastic web, each mass attached at base by a stalk to a viscid gland: stems mostly leafy and flowers spicate or racemose.

4. **Habenaria.** Flowers numerous, white or greenish. Lip flat, spurred. Glands exposed.

Tribe III. Anther one, erect and sessile or nearly so upon the top of the column and more or less covering and declinate upon the back of the stigma, persistent; pollen-masses 2 or 4, of loosely cohering granules, becoming attached by their upper ends to a viscid gland on the beak of the stigma: without spurs.

5. **Spiranthes.** Perianth oblique upon the ovary, the sepals and petals connivent: lip oblong, embracing the column, with 2 callosities at base. Flowers 1 to 3-ranked in a twisted spike. Stems leafy below.

6. **Goodyera**. Like the last, but lip saccate, entire, without callosities and free from the column. Leaves all radical, white-reticulated.
7. **Listera**. Perianth spreading. Lip flat, 2-lobed. Stem low, with a pair of broad sessile leaves in the middle.
8. **Epipactis**. Perianth spreading and ovary recurved. Lip somewhat jointed in the middle, concave and auriculate at base, dilated above. Stem leafy, stout.

Tribe IV. Perfect anthers 2, lateral, the sterile one forming a dilated fleshy appendage above the terminal stigma; pollen pulpy-granular.

9. **Cypripedium**. Perianth spreading. Lip an inflated sac. Stems leafy, bearing one or a few showy flowers.

1. CALYPSO, Salisb.

Petals and sepals ascending, similar and nearly equal; lip with two short spurs below the apex. Column petaloid, oval and concave. Lower pair of pollen-masses smaller, compressed. — A low herb, in bogs, with showy flowers, a scaly-sheathed stem, and a single radical broad thin leaf.

1. **C. borealis**, Salisb. Stem 3 to 6 inches high, with 2 or 3 membranaceous brownish green sheaths, and a linear acuminate bract at the summit: the radical leaf broadly ovate or slightly cordate: flower drooping: sepals and petals light rose-color; lip usually longer, brownish-pink mottled with purple, the edge margined at the apex and bifid or entire, about equalling the tooth like spurs and with a tuft of yellow hairs at base. — From Colorado to Oregon and British America; thence eastward to the North Atlantic States.

2. CORALLORHIZA, Haller. CORAL-ROOT.

Petals and sepals ascending, similar and nearly equal, but the lateral sepals oblique at base and either decurrent in a short spur adnate to the side of the ovary, or forming a projecting gibbosity above it. Column narrowly margined, broader at base, somewhat incurved. — Without green herbage, the solitary scape with 2 to 4 membranaceous sheaths, and bearing a simple raceme of brownish, yellowish, or purple flowers: pedicels reflexed in fruit.

* *Spur present: lip 3-lobed: flowers small, yellowish-green or whitish, often tinged or mottled with purple.*

1. **C. multiflora**, Nutt. Scape a foot or two high, many-flowered: sepals and petals 3-nerved; spur manifest, but wholly adnate to the ovary; lip nearly sessile, 3-lobed by a deep cleft on each side, the middle one rounded or emarginate, with undulate or denticulate margin: capsule 6 to 9 lines long, narrowed to a short rather stout pedicel. — Across the continent in north temperate latitudes, and in the Rocky Mountains southward to the Wasatch and Colorado.

2. **C. innata**, R. Br. Scape slender, 4 to 10 inches high, 3 to 15-flowered: sepals and petals 1-nerved; spur very short; lip somewhat 3-lobed by a lateral cleft, abruptly attenuate to the base; column stout, constricted in the middle: capsule 2 to 4 lines long, abruptly narrowed to a short very slender pedicel. — From Colorado to Washington, and thence eastward to Canada and the Atlantic States, and northward to the Arctic regions.

* * *Spur none, the lateral sepals and base of the column strongly gibbous over the top of the ovary: lip entire: flowers larger, purple and veined, not spotted.*

3. **C. striata**, Lindl. Scape stout, a foot or two high, many-flowered: flowers often 6 or 7 lines long; lip fleshy, somewhat narrowed below, reflexed above the base and bearing the prominent laminae upon the arch. — *C. Macraei*, Gray, Manual, 510. From Washington and Oregon eastward to the Great Lakes.

3. APLECTRUM, Torr. PUTTY-ROOT.

Lip 3-ridged. Column nearly straight, not broader at base. Scape lateral from a thick globose solid bulb upon a slender horizontal rootstock, the bulb bearing at summit a large petioled plaited leaf. Flowers rather large, soon deflexed.

1. **A. hiemale**, Torr. Scape with 3 or 4 greenish sheaths: the radical leaf ovate-oblong to broadly oblanceolate, 4 to 8 inches long, many-nerved, continuing through the winter: sepals and petals greenish-brown, 5-nerved; lip whitish or somewhat spotted, attenuate into a distinct claw: ovary attenuate into a slender pedicel. — Along our eastern border and eastward to the Atlantic; found also in Oregon.

4. HABENARIA, Willd.

Sepals and petals nearly alike, convergent or the lower sepals spreading. Lip without ridges or callosities. Column very short. Anther-cells parallel or divergent at base. — Stems from fleshy-fibrous or tuberous roots: flowers greenish or white, not showy in our species.

* *Stems slender, bracteate, with 2 or 3 leaves at base: sepals 1-nerved: spur longer than the lip.*

1. **H. Unalaschensis**, Watson. Spike of flowers elongated and rather open: leaves narrowly lanceolate to linear: bracts ovate, not exceeding the ovary: sepals, petals, and lip about a line long, the narrow or somewhat clavate spur scarcely or sometimes nearly twice longer. — *H. fœtida*, Watson, Bot. King Exped. 341. In the Wasatch, Uinta, and Teton Mountains, and along the Pacific coast to Oonalaska.

* * *Sepals 3-nerved: spur not longer than the entire lip.*

+ *Stem leafy.*

2. **H. hyperborea**, R. Br. *Leaves lanceolate, erect: spike dense: flowers greenish: lip and petals lanceolate, somewhat equal, the latter spreading from the base: glands orbicular: stalk of the pollen-masses very slender and weak.* — Colorado and northward, thence across the continent.

3. **H. dilatata**, Gray. Like the last, but more slender and with narrower commonly linear leaves: flowers white: lip lanceolate from a rhomboidal-dilated base, its base with the bases of other petals and sepals erect-connivent: glands approximate, large and strap-shaped, vertical, nearly as long as the pollen-mass and its short flat stalk together. — From Colorado northward and eastward.

+ + *Scape or stem naked above, one-leaved at the base.*

4. **H. obtusata**, Richardson. Leaf obovate or spatulate-oblong: upper sepal very broad and rounded: lip deflexed, about the length of the tapering and curving spur: anther-cells arcuate and widely separated. — Colorado and northward, thence eastward across the continent.

5. **SPIRANTHES**, Richard. LADIES' TRESSES

Dilated summit of the lip spreading and undulate. Column very short, oblique, terminating in a stout terete stipe. — Flowers small, white.

1. **S. Romanzoffiana**, Cham. Glabrous, rather stout, 4 to 18 inches high: leaves oblong-lanceolate to linear: spike dense, 3-ranked, conspicuously bracteate, 1 to 4 inches long: perianth curved; lip recurved, contracted below the rounded wavy-crenulate summit; callosities smooth, often obscure. — From Colorado northward and ranging across the continent.

6. **GOODYERA**, R. Br. RATTLESNAKE PLANTAIN.

Scapes few-bracteate: leaves thickish, rosulate at the base, petioled: root stock creeping, with fibrous fleshy rootlets.

1. **G. Menziesii**, Lindl. Scape and inflorescence pubescent: leaves smooth, ovate-oblong to oblong-lanceolate, reticulated with light greenish markings: spike many-flowered, rather dense, secund: perianth white, puberulent: column short and straight: gland and bifid beak very narrow and elongated. — From Colorado northward, thence eastward along the northern border to W. New York; also in the Pacific States.

7. **LISTERA**, R. Br. TWAYBLADE.

Sepals and petals similar: lip free, longer than the sepals. Column free and naked. — Stems from fibrous and creeping roots: flowers small, in a loose raceme.

1. **L. convallarioides**, Nutt. Stem slender, 3 inches to a foot high, naked excepting one or two sheaths at base and the pair of orbicular or ovate leaves just below the raceme: inflorescence pubescent: sepals and petals linear; lip oblong-ovate and cuneate, with a small tooth on each side near the base. — From the Sierra Nevada eastward across the continent.

2. **L. cordata**, R. Br. Leaves smaller, triangular-ovate and somewhat cordate: flowers minute, on short pedicels in a smooth raceme: sepals ovate; lip linear. — Same range as last.

8. **EPIPACTIS**, Haller.

Sepals and petals nearly equal: lip narrowly constricted in the middle. Column short, erect. — Stem from creeping rootstocks: flowers few and pedicelled, with conspicuous bracts divergent, and the ovaries at right angles to the stem.

1. **E. gigantea**, Dougl. One to four feet high, nearly smooth: leaves from ovate below to narrowly lanceolate above, somewhat scabrous on the

veins beneath: raceme pubescent: flowers greenish, strongly veined with purple: saccate base of the lip with erect wing-like margins, strongly nerved, and the nerves callous-tuberculate near the base. — W. Texas and S. W. Colorado to California and Washington.

9. CYPRIPIEDUM, L. LADY'S SLIPPER.

Lateral sepals often united into one under the lip: sac-like lip with the incurved margin auricled near the base. — Leaves large and many-nerved, plaited, sheathing at the base. In ours the stem is 1 to 3-flowered, the lip is slipper-shaped and much inflated, and the sepals and linear wavy-twisted petals are brownish, pointed, and longer than the lip.

1. **C. parviflorum**, Salisb. *Sepals ovate or ovate-lanceolate: lip flattish from above, bright yellow, fragrant: sterile stamen triangular: leaves oval, pointed.* — Colorado and eastward.

2. **C. pubescens**, Willd. Stem pubescent: *sepals elongated-lanceolate: lip flattened laterally, very convex and gibbous above, pale yellow, scentless: leaves broadly oval, acute.* — Colorado and eastward.

ORDER 77. IRIDACEÆ. (IRIS FAMILY.)

Perennial herbs, with equitant sheathing 2-ranked linear leaves, and perfect triandrous regular flowers, the six divisions of the superior perianth petal-like; stamens on the base of the sepals, with extrorse anthers; ovary 3-celled, becoming a 3-lobed or triangular pod with few or many seeds. — Flowers showy, few or solitary. Style 3-cleft at the apex.

1. **Iris**. Outer segments of the flower recurved, the inner erect. Branches of the style petaloid, opposite the anthers. Filaments distinct. Rootstocks creeping. Seeds flattened.

2. **Sisyrinchium**. Segments similar, spreading. Stigmas filiform, alternate with the anthers. Filaments connate. Roots fibrous. Seeds globular.

1. IRIS, Tourn. FLOWER-DE-LUCE. FLAG.

Perianth tube prolonged above the ovary. Stamens beneath the arching, petal-like branches of the style. Base of the style connate with the perianth tube; the divisions stigmatic at the thin apex, above which is a broad 2-parted crest, which is decurrent on the inner side to the base of the style. — Stems from usually thickened rootstocks: flowers large and showy, solitary or few in a forked corymb.

1. **I. Missouriensis**, Nutt. Stems rather slender, naked or with 1 or 2 leaves, $\frac{1}{2}$ to 2 feet high, usually 2-flowered: leaves mostly shorter than the stem: bracts dilated and scarious: flowers pale blue; sepals and petals 2 or 3 inches long, with narrow claws: seeds obovate, acute at base. — *I. Tolmieana*, Herbert. *I. tenax*? of Fl. Colorado. From Montana and Colorado westward to the Sierra Nevada, being probably the only species of the Great Basin.

2. SISYRINCHIUM, L. BLUE-EYED GRASS.

Perianth 6-parted. Capsule membranaceous, subglobose. — Stems simple or branched, usually geniculate and winged, with linear-lanceolate or grass-like radical leaves, and fugacious flowers on slender pedicels, clustered within 2 sheathing herbaceous bracts, with a scarious bractlet subtending each pedicel.

1. *S. anceps*, L. Scape *broadly winged*, and the outer leaf of the very unequal spathe longer than the flowers. — *S. Bermudiana*, var. *anceps*, of Gray's Manual. In the Atlantic States, but extending westward to the Wasatch and Uintas (*Watson*).

2. *S. mucronatum*, Michx. Scape slender and *narrowly winged*: leaves very narrow, those of the spathe sharp-pointed and unequal, one of them usually longer than the flowers. — *S. Bermudiana*, var. *mucronatum*, of Gray's Manual. Same range as last, but extending farther westward.

ORDER 78. AMARYLLIDACEÆ.

Like *Liliaceæ*, but ovary inferior. Differs from *Iridaceæ* in having six stamens and leaves not equitant.

1. HYPOXYS, L. STAR-GRASS.

Perianth persistent, spreading; the 3 outer divisions a little herbaceous outside. Pod crowned with the withered or closed perianth. Seeds globular. — Stemless small herbs, with grassy and hairy linear leaves and slender few-flowered scapes, from a solid bulb.

1. *H. juncea*, Smith. Sparingly hairy: scapes 1 to 3, filiform, 1 or 2-flowered, 4 to 9 inches long: bracts bristle-like, shorter than the villous pedicels: the three exterior divisions of the perianth greenish and hairy without: seeds black, minutely fitted. — Colorado (*Brandegee*).

ORDER 79. LILIACEÆ. (LILY FAMILY.)

Terrestrial plants, mostly herbaceous, with perfect flowers, a regular corolla-like 6-cleft or divided perianth, stamens opposite the segments, ovary 3-celled and superior becoming a few or many-seeded 3-celled capsule or berry. — Stems chiefly from tunicated or scaly bulbs, or corms, or rhizomes. — *Watson's Revision*, Proc. Am. Acad. xiv. 213.

1. Flowers with scarious bracts, a persistent perianth with segments one to several-nerved, perigynous stamens with introrse anthers, and an undivided and mostly persistent style.

* Inflorescence umbellate upon a naked scape from a bulb or corm; sessile upon a short rootstock in *Leucocorinum*.

† Bracts (usually 2) broad and spathaceous; capsule more or less deeply lobed; perianth cleft nearly to the base; bulb mostly tunicated.

1. **Allium.** Flowers deep rose-color to white. Base of the style enclosed between the lobes of the capsule and jointed upon the short axis. Filaments usually dilated at base. Leaves one to several. Taste and odor strongly alliaceous.
2. **Nothoscordum.** Flowers greenish or yellowish white. Capsule somewhat lobed, with the style obscurely jointed on the summit. Filaments filiform. Leaves several. Bulb not alliaceous.
- + + Bracts several, not spathaceous, distinct: capsule not lobed: perianth funnel-form: scape from a membranous- or fibrous-coated corm.
3. **Brodiaea.** Flowers blue. Stamens 6, in two rows, with naked filaments. Capsule ovate to oblong.
4. **Androstephium.** Flowers pale lilac. Stamens 6, in one row; the filaments united to form an erect tubular crown, with bifid lobes alternate with the anthers. Capsule subglobose-triquetrous.
- + + Acaulescent: bracts elongated linear: capsule triangular-obovate: perianth salverform, with linear tube: flowers on subterranean pedicels, from a short rootstock.
5. **Leucoerinum.** Flowers white, very fragrant. Style slender and elongated, dilated at the summit. Leaves narrowly linear, surrounded at base by scarious bracts.
- * * Inflorescence racemose or paniculate.
- + Flowers racemose on a naked scape from a tunicated bulb: fruit an ovate or oblong capsule.
6. **Camassia.** Flowers blue (or white), slightly gibbous; segments 3 to 7-nerved, spreading. Base of the style persistent. Raceme open. Leaves linear, flat.
- + + Flowers racemose, racemose-panicled, or in axillary fascicles, on leafy simple stems from creeping rootstocks: fruit a globose berry.
7. **Polygonatum.** Flowers white or greenish, gamophyllous, 6-lobed at the summit, in axillary pedunculate fascicles (or solitary). Stamens on the tube. Style slender, deciduous.
8. **Smilacina.** Flowers white, with distinct perianth-segments, in a racemose panicle or simple raceme. Stamens at the base. Style short, thick, persistent.
- + + + Flowers racemose-paniculate upon a stout leafy or leafy bracteate stem from a stout caudex or thick rootstock; anthers sagittate: fruit a berry or capsule: leaves numerous and crowded, linear, thick and more or less rigid, spinescent at apex.
9. **Yucca.** Perianth campanulate, white or whitish, segments distinct. Filaments clavate. Style stout and persistent. Usually with stout woody caudex.
- II. Flower bracts none or foliaceous, a deciduous perianth with net-veined segments, hypogynous stamens with extrorse anthers, deciduous styles united at least at base, and the fruit a loculicidal (except *Calochortus*) capsule or a berry.
- * Stems from a bulb or coated corm: fruit a many-seeded capsule: seeds horizontal or ascending.
- + Perianth-segments similar, naked: style long.
- ++ Bulb scaly: stem simple, strict, leafy: anthers versatile.
10. **Lilium.** Perianth-segments oblanceolate, with a linear nectariferous groove, usually spotted. Style undivided.
11. **Fritillaria.** Perianth-segments broader and concave, often mottled; nectary a shallow pit. Styles united to the middle or throughout.
- ++ Stem simple, low or dwarf, from a corm or tunicated bulb: anthers basifixed.
12. **Erythronium.** Perianth-segments oblanceolate, strongly revolute, callous-toothed each side of the grooved nectary. Styles usually distinct above. Stem lax, 2-leaved.
13. **Lloydia.** Perianth small, spreading, white with purplish veins and base. Style undivided. Stem leafy, usually 1-flowered. Alpine.
- + + Outer perianth-segments smaller, somewhat sepal-like; the inner broad and usually bearded: stigmas sessile.
14. **Calochortus.** Stem usually branched, from a coated corm. Anthers basifixed. Capsule usually septicidal.

- * * Stems from a short or creeping rootstock: fruit a reddish lobed berry: seeds pendulous.
15. **Streptopus.** Flowers apparently axillary, greenish-white or purplish. Anthers sagittate, cuspidate, on short deltoid or subulate filaments. Leaves clasping.
16. **Prosartes.** Flowers in fascicles (1 to 6-flowered) terminating the branches, white or greenish. Anthers oblong, obtuse, on slender filaments. Leaves with reticulated veinlets.
- III. Like the last, but perianth persistent with nerved segments, styles distinct, and capsule septicidal (loculicidal in *Xerophyllum*).
- * Flowers usually polygamous: anthers 1-celled, peltate on opening: stems leafy: leaves not rigid nor equitant.
17. **Veratrum.** Stem tall and stout, from a thick rootstock. Inflorescence paniculate, pubescent. Leaves broad, strongly nerved and plicate.
18. **Zygadenus.** Stem from a coated bulb. Inflorescence a raceme or subpaniculate, glabrous; perianth-segments glandular at base. Leaves linear.
- * * Flowers diceious, on naked pedicels, in a simple elongated raceme: stem very leafy: leaves thin, oblanceolate.
19. **Chamælirium.** Flowers white: segments narrowly linear-spatulate, equalling the stamens, which are shorter and abortive in the pistillate flowers. Seeds margined, and winged at each end.
- * * * Flowers perfect, on bracteolate pedicels, in a simple raceme: anthers 2-celled, introrse: seeds numerous: stem leafy: leaves equitant.
20. **Tofieldia.** Flowers involucrate with 3 scarious united bractlets. Styles short. Seeds appendaged.
- * * * * Flowers perfect, on naked pedicels, in a simple dense raceme: styles reflexed: seeds few: stem very leafy: leaves very narrow, rigid and rough-edged.
21. **Xerophyllum.** Flowers white, on long pedicels; segments 5 to 7-nerved. Seeds not appendaged.

1. ALLIUM, L. ONION.

Perianth-segments 1-nerved, usually somewhat spreading. Ovules 2 at the base of each cell. Capsule often crested. Seeds obovoid and wrinkled.

§ 1. *Bulbs caespitose, narrowly oblong and crowning a more or less persistent rhizome: spathe mostly 2-valved: leaves several, linear: scape terete.*

* *Leaves terete, hollow.*

1. **A. Schönoprasum, L.** Scape stout: umbel subcapitate: flowers rose-color; segments 4 or 5 lines long, acuminate: stamens included: capsule not crested. — From Canada and the Great Lakes to the Wind River Mountains of Wyoming, Oregon, and Alaska.

* * *Leaves flat or channelled.*

2. **A. cernuum, Roth.** Scape slender, $\frac{1}{2}$ to 2 feet high, from a bulb: leaves 1 to 4 lines wide: umbel open, nodding: flowers numerous, on very slender pedicels, rose-colored or white; segments 2 or 3 lines long, broad and acutish: stamens and style exerted: capsule crested. — From New Mexico to Oregon, British Columbia, and the Alleghany Mountains.

3. **A. brevistylum, Watson.** Scape 1 to $1\frac{1}{2}$ feet high, from a stout rhizome: leaves 2 to 4 lines wide: spathe 1-valved: umbel erect, few-flowered; pedicels 6 to 12 lines long: flowers deep rose-color; segments 4 to 5 lines long, narrow, long-acuminate, nearly twice longer than the stamens and style: capsule not crested. — Bot. King Exped. v. 350. N. W. Wyoming to S. Utah.

§ 2. *Bulbs mostly solitary, globose to ovate, not rhizomatous: leaves narrowly linear, flat or channelled: scape terete or nearly so.*

* *Bulb-coats more or less fibrous: leaves several.*

+ *Capsule not crested: spathe usually 3-valved.*

4. **A. Canadense**, Kalm. *Bulb-coats somewhat fibrous: scape a foot or more high: umbel mostly bulbiferous: flowers on slender pedicels (6 to 10 lines long), white or pinkish; segments narrowly lanceolate, obtusish, equalling or somewhat exceeding the stamens.* — Along our eastern border and eastward to the Atlantic States.

5. **A. mutabile**, Michx. Like the last: *bulbs densely and coarsely fibrous-coated: scape a foot or two high: umbel rarely or never bulbiferous: flowers white to rose-color; segments thin and lax in fruit, ovate to narrowly lanceolate, obtusish or acute, a third longer than the stamens.* — *A. reticulatum*, var. γ , Watson, Bot. King Exped. v. 486. From New Mexico and S. Colorado eastward to the Atlantic States.

6. **A. Nuttallii**, Watson. *Bulb usually smaller, very fibrous: scape low (4 to 6 inches high): pedicels shorter (4 to 6 lines long) and usually stouter: perianth-segments usually broader, acute or acuminate, rose-colored or white, rather rigid in fruit.* — Proc. Am. Acad. xiv. 227. *A. mutabile*, var. β , Watson. From Kansas and Colorado southward.

+ + *Capsule crested: spathe usually 2-valved.*

7. **A. reticulatum**, Fraser. *Scape 3 to 8 inches high: pedicels usually short (2 to 6 lines long); otherwise closely resembling A. mutabile.* — From New Mexico and Colorado to the Saskatchewan.

* * *Bulb-coats not fibrous: some of the outer membranous coats in most species marked by a peculiar reticulate venation: leaves several (2 to 4): spathe 2-valved.*

+ *Ovary not crested or obscurely so: scapes low.*

8. **A. Brandegei**, Watson. *Bulbs small, the reticulation of the coats horizontally oblong: leaves 2, exceeding the angular scape: pedicels slender, equal, about 4 lines long: flowers rose-colored; the segments broadly lanceolate, acute, nearly twice longer than the stamens, not serrulate.* — Proc. Am. Acad. xvii. 380. Elk Mountains, Colorado (*Brandegee*).

9. **A. acuminatum**, Hook. *Outer bulb-coats with a distinct coarse quadrate to hexagonal reticulation: pedicels 6 to 12 lines long: flowers deep rose-color; segments lanceolate, with acuminate recurved tips, rigid in fruit, a third longer than the stamens, the inner ones undulate-serrulate.* — From S. W. Colorado to the Wasatch and Uinta Mountains, N. California and Washington.

+ + *Ovary conspicuously 6-crested: perianth-segments not serrulate, mostly rose-colored.*

10. **A. stellatum**, Fraser. *Outer bulb-coats reddish, with a very close linear longitudinal reticulation: scape 6 to 18 inches high: pedicel 4 to 9 lines long: perianth-segments broad, acute: stamens and style exerted.* — From Wyoming to the Saskatchewan.

11. **A. bisceptrum**, Watson. *Bulbs light-colored; reticulation indistinct: scapes lower, frequently in pairs: perianth-segments oblong-lanceolate, acuminate,*

slightly exceeding the stamens: the alternate filaments with a broad deltoid adnate base.—Bot. King Exped. v. 351, pl. 37. In the Wasatch Mountains and westward to the Sierra Nevada.

* * * *Bulb-coats not fibrous: leaf solitary, narrowly linear or filiform, equalling or somewhat exceeding the low scape (1 to 3 inches): capsule prominently 6-crested: stamens and style included.*

12. **A. Nevadense**, Watson. Bulb-coats light-colored, with evident close very much distorted reticulation: spathe-valves acuminate: leaf flat: pedicels half-inch long: perianth white or pinkish; segments lanceolate, little exceeding the stamens and style.—Bot. King Exped. v. 351, pl. 38. From the Wasatch Mountains to the Sierra Nevada.

§ 3. *Bulbs ovate, not rhizomatous, the membranous coats mostly without reticulation: leaves 2, broadly linear, flat and falcate, thick: scape stout, much compressed and 2-winged, low and mostly shorter than the leaves.*

13. **A. Tolmiei**, Baker. Scape 2 to 4 inches high: spathe 2-valved: flowers light rose-color with a darker midvein; segments lanceolate, acute, gibbous at base, a half longer than the stamens: ovary very obscurely crested.—*A. tribracteatum*, Watson in Bot. King Exped. v. 353, in part. From the Wasatch Mountains to S. Idaho.

2. NOTHOSCORDUM, Kunth.

Like *Allium*. Capsule oblong-obovate; cells several-ovuled. Bracts 2. Bulb tunicated.

1. **N. striatum**, Kunth. Bulb small, often bulbiferous at base: leaves a line or two broad: scape a foot high or often much less: flowers few, on slender pedicels: capsule 2 lines long.—*Allium striatum*, Jacq. From New Mexico to Nebraska and eastward to Virginia and Florida.

3. BRODIÆA, Smith.

Scape erect, with linear leaves: flowers on jointed pedicels: brown-coated corms small, $\frac{1}{2}$ to $\frac{3}{4}$ inch in diameter or less. In ours the perianth is broadly tubular and the flowers subcapitate.

1. **B. Douglasii**, Watson. Scape smooth, a foot or two high, erect and usually stout: leaves carinate: perianth-tube subsaccate, about equalling the lobes: anthers oblong; the lower on the throat opposite the outer segments, the upper on the inner segments, on a short free filament which forms below a prominent wing within the tube.—Bot. Calif. ii. 154. *Milla grandiflora*, Baker. "Blue Cammas." From W. Wyoming and the Wasatch to Oregon and Washington.

4. ANDROSTEPHIUM, Torr.

Perianth 6-cleft, the cylindric tube nearly equalling or shorter than the lobes.—Scape bearing a few-flowered umbel with unjointed pedicels: leaves narrowly linear, channelled.

1. **A. violaceum**, Torr. Scape 2 to 6 inches high: flowers 8 to 12 lines long or more, usually exceeding the stout pedicels; tube nearly as long as the limb; crown scarcely shorter than the limb, the lobes exceeding the anthers. — Bot. Mex. Bound. 218. W. Kansas to Texas.

5. LEUCOCRINUM, Nutt.

Stamens 6: filaments inserted below the throat. — Blooming in early spring, the pure white and very fragrant flowers appearing just above the ground.

1. **L. montanum**, Nutt. Leaves several, rather thick: flowers 4 to 8, the very slender tube an inch or two long: capsule truncate, with 4 to 6 seeds in each cell. — From Colorado to N. California.

6. CAMASSIA, Lindl. CAMASS.

Stamens 6, on the base of the perianth, shorter than the segments. Style slightly trifid at the apex. — Flowers in a simple raceme, with narrow scarious bracts; pedicels jointed at the summit.

1. **C. esculenta**, Lindl. Scape stout, a foot or two high: pedicels rather stout, mostly shorter than the usually dark-blue flowers: perianth-segments scarcely exceeding the style, a little longer than the stamens. — From the Wahsatch Mountains, northward and westward. The bulb largely collected for food by the Indians, and called "Green Cammas."

7. POLYGONATUM, Tourn. SOLOMON'S SEAL.

Ovules 1 to 3 pairs in each cell. Berry blue or black; cells 1 to 2-seeded. — Stem somewhat curved: leaves sessile: bracts caducous, minute.

1. **P. giganteum**, Dietr. Glabrous throughout: stem 2 to 7 feet high: leaves broadly ovate to lanceolate, usually clasping by a broad base: pedicels jointed below the base of the flower. — From the Upper Missouri and New Mexico to New England and Virginia.

8. SMILACINA, Desf. FALSE SOLOMON'S SEAL.

Stamens 6: filaments subulate. Stigma 3-lobed at the summit: ovules 2 in each cell. — Stems simple, leafy, from running rootstocks: leaves mostly sessile, oblong or lanceolate: pedicels jointed at the summit.

* *Flowers in a terminal racemose panicle: stamens exerted: berry reddish.*

1. **S. amplexicaulis**, Nutt. More or less pubescent: stem 1 to 3 feet high: leaves ovate to lanceolate, mostly sessile and clasping at base: style nearly equalling the ovary. — *S. racemosa*, var. *amplexicaulis*, Watson, Bot. King Exped. v. 345. From New Mexico to Wyoming and westward to California and British Columbia.

** *Flowers in a simple few-flowered open raceme: stamens included: berry blue-black.*

2. **S. stellata**, Desf. Glabrous or pubescent: stem a foot high or less: leaves lanceolate, acutish, sessile and closely clasping, usually ascending and

folded: raceme about an inch long.—From New Mexico to Oregon and Labrador.

3. *S. sessilifolia*, Nutt. Rootstock slender: stem a foot or two high: leaves lanceolate, *acuminate, sessile, usually flat and spreading*, somewhat puberulent: *raceme larger and pedicels longer (2 to 7 lines).*—Watson in Proc. Am. Acad. xiv. 245. From the Wasatch to California and British Columbia. Usually referred to *S. stellata*.

9. YUCCA, L. SPANISH BAYONET.

Segments of perianth ovate-lanceolate, many-nerved. Stigmas emarginate and more or less connate into a stigmatic tube. Fruit incompletely 6-celled. Flowers usually solitary and nodding. — In ours the caudex is short or none.

* *Fruit baccate, pendulous: seeds thick, rugose, not margined, with lobed or ruminated albumen.*

1. *Y. baccata*, Torr. Leaves coarsely filamentose on the margin, very thick and rigid, $1\frac{1}{2}$ to 3 feet long by an inch or two wide, channelled or concave, rough especially on the back, tipped by a very stout brown spine: panicle pedunculate: perianth-segments narrow, $2\frac{1}{2}$ to 3 inches long: fruit oval or cylindric, dark purple, often long-beaked. — S. Colorado and W. Texas to S. California and Northern Mexico.

* * *Fruit capsular, erect: seeds thin, smooth, broadly margined, with entire albumen.*

2. *Y. angustifolia*, Pursh. Leaves filamentose on the margin, very stiff and pointed, usually 1 to 3 feet long by 3 to 6 lines wide, smooth: raceme usually simple, nearly sessile, 1 to 4 feet long: flowers greenish-white or tinged with brown; segments broadly ovate, an inch or two long: fruit 6-sided. — From New Mexico to the Dakotas.

10. LILIUM, L. LILY.

Stems leafy, simple: leaves narrow, sessile, whorled or scattered, net-veined: flowers large and showy, in ours usually solitary and erect.

1. *L. Philadelphicum*, L. Bulb small, of thick fleshy jointed scales: leaves linear-lanceolate, whorled or scattered: perianth-segments reddish-orange, coarsely spotted on the lower half, acute, spreading, abruptly narrowed to the claw. — From Colorado to the Saskatchewan and eastward to N. Carolina and Canada.

11. FRITILLARIA, L.

Stems erect, simple, leafy: flowers often nodding and much smaller than in *Lilium*.

1. *F. atropurpurea*, Nutt. Bulb of numerous thick scales: *stem 8 to 15 inches high or more*, 1 to 6-flowered: *leaves 6 to 20*, scattered or somewhat verticillate: *flowers dull purple with more or less of yellowish green: styles distinct above; stigmas linear: capsule acutely angled, broadly obovate.* — From Wyoming to the Sierra Nevada.

2. **F. pudica**, Spreng. Bulb of numerous very small rounded scales: stem 3 to 8 inches high, 1 to 6-flowered: leaves 3 to 8, scattered or somewhat verticillate: flowers usually solitary, nodding, yellow or orange and tinged with purple: styles connate and stigma shortly 3-lobed: capsule oblong to subglobose. — From Utah and Montana to the Sierra Nevada and British Columbia.

12. ERYTHRONIUM, L. DOG'S-TOOTH VIOLET.

Stem bearing near the base a pair of closely approximate flat dilated net-veined leaves: flowers showy, solitary or few in a naked raceme.

1. **E. grandiflorum**, Pursh. Leaves not mottled, opposite: flowers 1 to 6, yellow or cream-colored, with a more or less orange base, 1 or 2 inches long: capsule narrowly oblong.

Var. **minor**, Morren. Flowers smaller, an inch long, bright yellow. — Colorado and Utah.

13. LLOYDIA, Salisb.

The bulb upon an oblique rhizome, covered by the persistent scarious bases of the nearly filiform leaves.

1. **L. serotina**, Reichenb. Stem 2 to 6 inches high, equalling the leaves: flowers erect; perianth-segments oblanceolate, obtuse, obscurely pitted at base. capsule obovate, obtusely angled: seeds chestnut-colored. — Mountains of Colorado and northward throughout the alpine and arctic regions of the northern hemisphere.

14. CALOCHORTUS, Pursh.

Stems usually flexuous and branching: leaves few, linear-lanceolate, radical and canline, the latter alternate and clasping, all with many nerves and transverse veinlets: flowers few, showy. In ours the flowers are open-campanulate, white or lilac, with densely hairy glands, and the capsule narrowly oblong with thick obtusely angled lobes.

1. **C. Nuttallii**, Torr. & Gray. Stem slender, bulbiferous at base, with a single narrow canline leaf (sometimes 2 or 3), umbellately 1 to 5-flowered: sepals often with a dark or hairy spot: petals an inch or two long, white tinged with greenish yellow or lilac, with a purplish spot or band above the yellow base, and hairy around the circular or oblong gland: anthers obtuse. — Pacif. R. Rep. ii. 124. From New Mexico and Colorado to the Dakotas and California.

2. **C. Gunnisoni**, Watson. Like the last, but with acuminate anthers and a broad transverse gland: petals light lilac, yellowish green below the middle, banded and lined with purple. — Bot. King Exped. v. 348. Mountains from Wyoming to New Mexico.

15. STREPTOPUS, Michx.

Stems rather stout, with forking and divergent branches, ovate and taper-pointed rounded-clasping membranaceous leaves, and small flowers on slender peduncles, which are abruptly bent or contorted near the middle.

1. **S. amplexifolius**, DC. Stem 2 to 3 feet high: leaves very smooth, glaucous underneath: anthers tapering to a slender point: stigma entire, truncate. — Across the continent in northern latitudes and ranging south to New Mexico.

16. **PROSARTES**, D. Don.

Low and pubescent, divergently branched above, with closely sessile ovate and membranaceous leaves, and drooping flowers. In ours the stigma is 3-cleft.

1. **P. trachycarpa**, Watson. Leaves ovate to oblong-lanceolate, acute or rarely acuminate: perianth-segments whitish, slightly spreading, acute: fruit broadly obovate, obtuse and rather deeply lobed, papillose. — Bot. King Exped. v. 344. Colorado to Utah and the Saskatchewan.

17. **VERATRUM**, Tourn. FALSE HELLEBORE.

The pubescent panicle mostly staminate below, with green or greenish bracts. In ours the leaves are broad-elliptical and sheathing, the ovary glabrous, and the capsule many-seeded.

1. **V. Californicum**, Durand. Stem 2 to 7 feet high: upper leaves lanceolate, but rarely acuminate: branches of the sometimes compound panicle ascending: perianth-segments obtuse, whitish with greener base, often denticulate above. — *V. album*, Watson. From Colorado and Wyoming to N. California and Oregon.

18. **ZYGADENUS**, Michx.

Stem from a coated bulb crowning a short rhizome, with narrowly linear obscurely nerved leaves mostly near the base: otherwise as *Veratrum*. In ours the gland covers more or less of the base of the perianth-segments.

* *Flowers rather large, mostly perfect.*

1. **Z. elegans**, Pursh. Stem $\frac{1}{2}$ to 3 feet high: leaves glaucous, 2 to 6 lines broad: raceme often few-flowered: bracts ovate-lanceolate, usually purplish: perianth adnate at base; segments broad, greenish, the inner abruptly contracted to a broad claw; gland obcordate. — *Z. glaucus*, Nutt. From New Mexico to Oregon and Canada.

2. **Z. Nuttallii**, Gray. Stem stout, 2 feet high: leaves 3 to 8 lines broad: raceme rather densely flowered, with narrow membranous bracts: perianth free from the ovary; segments not clawed, with an ill-defined gland at base. — Manual, 525. From Colorado to Texas.

* * *Flowers smaller, polygamous.*

3. **Z. venenosus**, Watson. Stem slender, $\frac{1}{2}$ to 2 feet high: leaves 2 or 3 lines broad, scabrous, the cauline not sheathing: raceme simple, short: perianth-segments triangular-ovate to elliptical, obtuse or rarely acutish, all abruptly contracted to a short glandular claw; gland extending slightly above the claw with a well-defined irregular margin: seeds $1\frac{1}{2}$ to $2\frac{1}{2}$ lines long. — Proc. Am. Acad. xiv. 279. From the Wasatch to California and British Columbia. Known as "Death-Camass" or "Hogs' Potato."

4. **Z. paniculatus**, Watson. Very similar: *usually stout: leaves 3 to 8 lines broad, usually all sheathing: raceme compound: perianth-segments deltoid, acute or acuminate; gland less definitely margined, often reaching nearly to the middle of the blade: seeds 3 to 5 lines long.* — Bot. King Exped. v. 344. From the Wasatch Mountains to California and the Saskatchewan.

19. CHAMÆLIRIUM, Willd. DEVIL'S-BIT.

Stem wand-like, from a thick and abrupt tuberous rootstock, terminated by a long spiked raceme of small bractless flowers: fertile plant more leafy than the staminate.

1. **C. Carolinianum**, Willd. Stem 1 to 4 feet high: lower leaves spatulate-oblongate, 2 to 6 inches long, the cauline narrower. — *C. luteum*, Gray, Manual, 527. Coming into our eastern limit in W. Nebraska and extending eastward.

20. TOFIELDIA, Huds. FALSE ASPHODEL.

Mostly tufted, with fibrous roots, and simple stems leafy only at base, bearing small flowers in a close raceme: leaves linear, grass-like. Ours has stem and inflorescence pubescent, and pedicels fascicled.

1. **T. glutinosa**, Willd. Glutinous-pubescent: stem slender, $\frac{1}{2}$ to $1\frac{1}{2}$ feet high: raceme short: pedicels bearing the scarcely lobed involucre near the flower: capsule shortly beaked: seeds minute, with brownish testa, and a contorted tail at each end. — From Wyoming to Oregon and northward, also eastward to Canada and N. Carolina.

21. XEROPHYLLUM, Michx.

Stem from a bulbous base, bearing a compact raceme of showy white flowers, thickly beset with needle-shaped leaves, the upper ones reduced to bristle-like bracts; those from the root very many in a dense tuft.

1. **X. Douglasii**, Watson. Stem 2 to 4 feet high: leaves often 2 or 3 feet long: pedicels $\frac{1}{2}$ to $1\frac{1}{4}$ inches long: flower-segments $2\frac{1}{2}$ lines long, exceeding the stamens: capsule cordate-ovate, 6-valved, the abruptly acute cells separating and then dehiscing. — Proc. Am. Acad. xiv. 284. *X. tenax* of the Hayden Reports. Headwaters of the Yellowstone and westward to Oregon.

ORDER 80. SMILACEÆ. (SMILAX FAMILY.)

Shrubby or rarely herbaceous plants, climbing or supported by a pair of tendrils on the petiole of the ribbed and netted-veined simple leaves; with diœcious small flowers; regular perianth of 6 similar deciduous sepals, free from the ovary; as many stamens as sepals; with introrse 1-celled anthers; ovary with 3 cells and as many elongated spreading sessile stigmas.

1. **SMILAX**, TOURN. GREEN BRIER.

Characters of the order: flowers in umbels.

1. **S. rotundifolia**, L. Stem armed with scattered prickles, as well as the terete branches: branchlets more or less 4-angular: leaves ovate or round-ovate, slightly heart-shaped, abruptly short-pointed: berries blue-black, with a bloom. — Colorado and eastward.

ORDER 81. **COMMELYNACEÆ**. (SPIDERWORT FAMILY.)

Herbs, with fibrous or sometimes thickened roots, jointed and often branching leafy stems, and chiefly perfect and 6-androus, often irregular flowers, with the perianth free from the 2 to 3-celled ovary, and having a distinct calyx and corolla, of 3 persistent sepals and as many ephemeral or deciduous (in ours blue) petals. Style one, stigma undivided. Pod 3 to several-seeded. — Leaves ovate, lanceolate or linear, parallel-veined, flat, sheathed at the base; the uppermost often forming a kind of spathe.

1. **Commelyna**. Flowers irregular. Three stamens fertile and three sterile and smaller: filaments naked.
2. **Tradescantia**. Flowers regular. Stamens all fertile: filaments bearded.

1. **COMMELYNA**, DILL. DAY-FLOWER.

Sepals somewhat colored, unequal; the 2 lateral partly united by their contiguous margins. Two lateral petals rounded, on long claws, the odd one smaller. Sterile stamens with imperfect cross shaped anthers. — Stems branching, often procumbent and rooting at the joints: floral leaf heart-shaped and clasping, folded together or hooded, forming a spathe enclosing the flowers, which expand for a single morning and are recurved on their pedicels before and afterwards.

1. **C Virginia**, L. Stems slender, erect, or reclined and rooting towards the base: leaves oblong- or linear-lanceolate: spathes peduncled, conduplicate, round-heart-shaped when expanded, in fruit somewhat hood-like. — E. Colorado and eastward to New York.

2. **TRADESCANTIA**, L. SPIDERWORT.

Sepals herbaceous. Petals all alike, ovate, sessile. — Stems mostly upright, nearly simple, leafy: leaves keeled: flowers ephemeral, in umbelled clusters, terminal (in ours): floral leaves nearly like the others.

1. **T. Virginica**, L. Leaves lance linear, elongated, tapering from the sheathing base to the point, ciliate: umbels sessile, clustered, usually involucrate by 2 leaves, many-flowered. — From New Mexico northward and eastward across the continent.

ORDER 82. JUNCACEÆ. (RUSH FAMILY.)

Grass-like or sedge-like herbs, with small flowers, a regular and hypogynous persistent perianth of 6 similar glumaceous sepals, 6 or rarely 3 stamens, a single short style, 3 filiform hairy stigmas, and an ovary 1 or 3-celled. — Plants with liliaceous flowers and sedge-like appearance and texture.

1. **Luzula.** Pod 1-celled, 3-seeded. Plant often hairy.
2. **Juncus.** Pod 3-celled, or 1-celled by the placenta not reaching the axis, many-seeded. Plant never hairy.

1. LUZULA, DC. Wood-Rush.

Pod with one seed to each parietal placenta. Generally in dry ground, with usually flat and soft usually hairy leaves, and spiked-crowded or umbelled flowers.

* *Pedicels 1-flowered, in a loose compound cyme.*

1. **L. spadicea**, DC. Glabrous or slightly villous: stems 6 to 18 inches high or more: inflorescence lax and nodding, much exceeding the usually small involucre bracts: perianth straw-color or more or less tinged with brown; segments slightly shorter than the acute apiculate capsule: anthers much exceeding the filaments: seed oblong, brownish, not appendaged — Ranging from the Arctic Ocean southward into California, Colorado, and the N. Atlantic States; chiefly the following varieties:

Var. **parviflora**, Meyer. Inflorescence often 3 to 6 inches long, with elongated unequal drooping branches and slender pedicels: flowers smaller: anthers about equalling the filaments.

Var. **melanocarpa**, Meyer. Similar, but capsule dark brown. — *L. parviflora*, var. *melanocarpa*, Gray, Manual.

Var. **subcongesta**, Watson. Like the others, but the pedicels short and more or less fasciated at the ends of the branches of the cyme. — Bot. Calif. ii. 202.

* * *Flowers spicate: spikes erect, mostly pedunculate in a cymose umbel.*

2. **L. comosa**, Meyer. Villous: stem 6 to 15 inches high, leafy: the foliaceous bract usually exceeding the inflorescence: peduncles 2 to 12, unequal, the longer 1 to 3 inches long: spikes simple, usually oblong, loosely flowered: perianth pale or somewhat tinged with brown, equalling the capsule: anthers small, equalling the filaments: seed dark, with a white conical appendage sometimes half as long as the seed. — The type, together with the following varieties, ranges from the Rocky Mountains westward and northward.

Var. **macrantha**, Watson. Perianth longer, much exceeding the capsule: anthers equalling or twice longer than the filaments: seed larger, the appendage always short. — Bot. Calif. ii. 203.

Var. **subsessilis**, Watson. Spikes solitary or few, nearly sessile, loose; perianth-segments lax and scarious. — Bot. Calif. loc. cit.

3. **L. campestris**, DC. Similar to the preceding type, but usually less villous: bracts short: spikes dense, short, and ovate: perianth-segments often

dark-brown. — Rather rare in California, Colorado, etc., but common in the Atlantic States.

4. **L. spicata**, Desv. *Leaves carinate and folded: flowers in a solitary and compound dense nodding spike: seed not appendaged.* — An alpine species in the mountains of Colorado, and in similar situations northward and eastward.

2. JUNCUS, L. RUSH. ROG-RUSH.

Stamens when 3 opposite the 3 outer sepals. — Generally in wet soil or water, with pithy or hollow simple stems, and paniced or clustered small greenish or brownish flowers.

* *Scape naked, the basal sheath also leafless, or rarely bearing terete leaves similar to the scape: flowers in sessile apparently lateral panicles: stamens 6 in ours.* — TRUE JNCI.

+ *Flowers many; panicle more or less compound: sheaths leafless.*

1. **J. Balticus**, Deth. *Rather stout: sepals nearly equal and similar, or the inner more obtuse: capsule ovate-pyramidal, angled, beaked: seeds smaller, narrower, and longer apiculate than in the eastern form.* — Ranging across the continent. Known as "Wire grass."

2. **J. filiformis**, L. *Very slender: panicle almost simple: sepals exceeding the broadly ovate obtuse short-pointed greenish capsule.* — From Colorado to the Saskatchewan and eastward across the continent.

+ + *Flowers few; panicle scarcely ever compound: sheaths often leaf-bearing: seeds caudate: low and alpine.*

3. **J. Drummondii**, E. Meyer. *Stems 1 to 1½ feet high, terete and filiform: sheaths bristle-pointed: spathe more or less exceeding the simple 1 to 3-flowered panicle: capsule ovate-oblong, triangular, retuse: seeds ovate.* — Mountains of Colorado to California and northward.

4. **J. Hallii**, Engelm. *Stems 6 to 12 inches high, terete and filiform, much longer than the terete bristleform leaves: spathe scarcely exceeding the close subsimple 2 to 5-flowered panicle: sepals white-margined: capsule ovate, angled, retuse: seeds oblong-linear.* — Trans. St. Louis Acad. ii. 446. Colorado.

5. **J. Parryi**, Engelm. *Stems 4 to 8 inches high, setaceous, longer than the sulcate subterete leaves: spathe exceeding the 1 to 3-flowered panicle: outer sepals bristle-pointed: capsule prismatic, pointed: seeds oblong.* — Loc. cit. Mountains of Colorado to California and northward.

* * *Stems naked or leafy: leaves flat, or semi-terete and channelled, never knotted: panicle or head evidently terminal: stamens 6 in ours.* — GRASSY-LEAVED JNCI.

+ *Alpine: seeds caudate: leaves fistulous: flowers in small heads.*

6. **J. triglumis**, L. *Leaves roundish, channelled and 2 to 3-tubular below, flattened upward: sheaths awicled at top: head equalling the membranous spathe: capsule elliptical, acute.* — Mountains of Colorado and northward to the Arctic coast.

7. **J. castaneus**, Sm. *Stem leafy: leaves terete, deeply channelled at base: heads somewhat in pairs sessile or peduncled, shorter than the rather large spathe: capsule oval-triangular and rather long mucronate.* — Mountains of Colorado northward to British America and thence across the continent.

← ← *Flowers solitary, paniced.*

↔ *Stems slender, simple, tufted, leafy below.*

8. **J. Vaseyi**, Engelm. *Leaves slightly channelled at base: panicle light-colored, loose, few-flowered: capsule ovate, retuse: seeds conspicuously caudate at both ends.* — Loc. cit. From Colorado to Michigan and the Saskatchewan.

9. **J. tenuis**, Willd. *Leaves flat: perianth-segments pale: sepals exceeding the ovoid retuse green capsule: seeds white-pointed at both ends.* — Everywhere throughout the United States.

Var. **congestus**, Engelm. *Panicle contracted and somewhat capitate: perianth and capsule darker.* — Loc. cit. 450. Colorado and California.

↔ ↔ *Stems branched, diffused, leafy.*

10. **J. bufonius**, L. Low and slender: panicle spreading, mostly with one-sided dichotomous branches: the 3 outer sepals much longer than the inner and than the oblong obtuse pod: seeds elliptical, obtuse. — Common everywhere.

← ← ← *Flowers capitate: seeds not caudate.*

11. **J. longistylis**, Torr. & Gray. Stems 1 to 2 feet high, leafy: leaves flat, grass-like: heads few in a contracted panicle, or rarely single: flowers greenish with brown lines: sepals equal, a little shorter or equalling the ovate, obtuse, mucronate or rostrate, chestnut colored capsule: seeds oblan- ceolate or obovate, pointed. — From New Mexico to the Saskatchewan and Washington.

* * * *Stem leafy: leaves knotted by internal cross-partitions: panicle terminal, with the flowers in heads.* — KNOTTY-LEAVED JUNC.

← *Leaves terete or slightly compressed.*

↔ *Seeds barely pointed: stamens 6.*

12. **J. alpinus**, Vill., var. **insignis**, Fries. Stem 9 to 18 inches high: panicle erect, elongated, greenish or light-brown: heads few-flowered: sepals obtuse: capsules light-brown, obtuse, mucronate, 3-celled: seeds spindle-shaped. — From Colorado northward, also eastward to New York.

13. **J. nodosus**, L., var. **megacephalus**, Torr. Stem stout, 1 to 3 feet high, with thick leaves: panicle pale green: heads many-flowered: sepals awl-pointed: capsules slender, triangular, taper-pointed, one-celled: seeds obovate, abruptly mucronate. — From New Mexico to California and New York.

↔ ↔ *Seeds caudate: stamens 3.*

14. **J. Canadensis**, J. Gay. Tufted stems erect, bearing 2 or 3 leaves: heads few to many-flowered: outer sepals the shorter: capsule triangular-prismatic, one-celled, mostly exsert and short-pointed.

Var. **coarctatus**, Engelm. Stem slender, bearing fewer deep-brown 3 to 5-flowered heads in a somewhat erect contracted panicle: sepals much shorter than the pod. — Gray's Manual, 544. Yellowstone Park; also eastward from Wisconsin to New England.

← ← *Leaves compressed and equitant, ensiform: stem compressed and usually acutely edged.*

15. **J. Mertensianus**, Meyer. Stems weak, from slender matted root-stocks, 6 to 18 inches high, not 2-edged: leaves very narrow, the sheaths with ligules: heads solitary, densely many-flowered, dark brown: capsule obovate, obtuse. — From Colorado to California and Alaska.

16. **J. xiphioides**, Meyer. Stems from a thick creeping rootstock, 2 to 4 feet high, 2-edged: leaves usually broad, the sheaths without ligules: heads numerous, brownish, few to many-flowered, in a compound panicle: capsule oblong, acute.

Var. **montanus**, Engelm. Lower and leaves narrower: heads few, usually many-flowered. — Trans. St. Louis Acad. ii. 481. From New Mexico to Washington and the Saskatchewan.

ORDER 83. **TYPHACEÆ.** (CAT-TAIL FAMILY.)

Marsh or aquatic herbs, with nerved and linear sessile leaves, and monœcious flowers on a spadix or in heads, destitute of proper floral envelopes. Ovary tapering into a style. Fruit nut-like, 1 or 2-seeded.

1. **Typha.** Flowers in a long very dense cylindrical spike terminating the stem.
2. **Sparganium.** Flowers in separate dense spherical leafy-bracted heads, which are scattered along the summit of the stem.

1. **TYPHA**, Tourn. CAT-TAIL FLAG.

Upper part of the spike consisting of stamens only, intermixed with long hairs; the lower or fertile part consisting of ovaries, surrounded by club-shaped bristles. Nutlets minute, very long-stalked. — Leaves long, sheathing the base of the simple jointless stems.

1. **T. latifolia**, L. Leaves flat: staminate and pistillate parts of the spike approximate. — Across the continent.

2. **SPARGANIUM**, Tourn. BUR-REED.

The upper heads consisting of stamens only, with minute scales irregularly interposed; the lower larger, consisting of numerous sessile pistils, each surrounded by 3 to 6 scales. Fruit wedge-shaped or club-shaped. — Stems simple or branching, sheathed below by the base of the linear leaves.

* *Erect, with branched inflorescence of numerous heads: pistil as long as the truncate scales: nuts sessile, wedge-shaped, angular: leaves mostly flat and merely keeled, the base triangular with concave sides.*

1. **S. eurycarpum**, Engelm. Stems stout, 2 to 4 feet high: fruit many-angled when ripe, with a broad and depressed summit abruptly tipped in the centre. — From Nevada northward and eastward across the continent.

* * *Erect or rarely floating, with simple or branched inflorescence of numerous heads: pistil with conspicuous style longer than the spatulate denticulate scales: nuts attenuated at both ends, with a stalked base, nearly terete: leaves floating or triangular with flat sides in the lower half.*

2. **S. simplex**, Hudson. Erect, 9 to 15 inches high, slender: inflorescence simple, the lower heads supra-axillary, sessile or peduncled: fruit more or less contracted in the middle. — Across the continent. Exceedingly variable, the following varieties coming within our range:

Var. **androcladum**, Engelm. Stouter and taller: inflorescence branched below; branches bearing numerous sterile heads: fruit larger, not contracted, long-tapering at both ends. — Gray's Manual, 481.

Var. **angustifolium**, Engelm. Leaves floating: inflorescence simple: fruit smaller, short-stiped, contracted in the middle. — Loc. cit.

* * * *Usually floating, with very slender stems and delicate always flat and narrow leaves: inflorescence simple, of few small heads: scales oval or obovate, denticulate: nuts oval, with a very short stipe and short point.*

3. **S. minimum**, Baubin, Fries. Fertile heads solitary or two, axillary, sessile, or the lower one peduncled: nuts somewhat triangular, contracted below: stems when out of the water only 5 to 6 inches high. — Uinta Mountains, and northward, thence eastward to New England.

ORDER 84. LEMNACEÆ. (DUCKWEED FAMILY.)

Minute stemless plants, floating free on the water, destitute of distinct stem and foliage, being merely a disk-like frond producing one or few monœcious flowers from the edge or upper surface, and commonly hanging roots from underneath; fruit a utricle, and seed large.

1. **Lemna**. Frond 1 to 5-nerved, with a single rootlet.

2. **Speirodela**. Frond 7 to 11-nerved, with several rootlets.

1. LEMNA, Linn. DUCKWEED. DUCK'S-HEAT.

Flowers marginal, bracteate, diandrous. Anther-cells bilocellate by a transverse partition, dehiscing transversely. Seeds 1 to 6. — Rootlet destitute of vascular tissue.

1. **L. trisulca**, L. *Fronds thin, oblong or oblong-lanceolate, attenuate at base into a slender stalk, very obscurely 3-nerved, usually several series of offshoots remaining connected: seeds ovate.* — From New Mexico to Oregon, the Saskatchewan, and eastward through most of North America.

2. **L. minor**, L. *Fronds rather thick, round- to elliptic-obovate, sessile, very obscurely 3-nerved, the offshoots soon separating: seeds oblong-obovate.* — Abundant everywhere, closely covering the surface of stagnant pools.

2. SPEIRODELA, Schleiden.

Like *Lemna*, but anther-cells bilocellate by a vertical partition and dehiscence longitudinally, and ovary 2-celled. — Rootlets with axile vascular tissues.

1. **S. polyrrhiza**, Schleid. *Fronds round-obovate, purple beneath: roots clustered, usually 3 to 5.* — *Lemna polyrrhiza*, L. Nevada, Montana, Wyoming, and eastward throughout the continent. Very rarely seen in flower or fruit.

ORDER 85. **ALISMACEÆ.** (WATER-PLANTAIN FAMILY.)

Marsh herbs, with scape-like stems, sheathing leaves, and perfect or monœcious flowers not on a spadix, furnished with both calyx and corolla; sepals and petals each 3, distinct; ovaries numerous, distinct, becoming akenes in fruit. — Roots fibrous; leaves radical, petiolate, strongly nerved with transverse veinlets, the earlier sometimes without blade; flowers in a loose raceme or panicle.

1. **Alisma.** Flowers perfect. Carpels verticillate, obovate-oblong, flattened.
2. **Sagittaria.** Flowers monœcious or dioecious. Carpels capitate, flattened and membranously winged.

1. **ALISMA, L.** WATER-PLANTAIN.

Petals small. Stamens 6, rarely more. Ovaries on a disk-like receptacle. Akenes in a crowded whorl, somewhat channelled on the back, obtuse. — Herbs in shallow water or mud, with small flowers in a verticillately branched panicle.

1. **A. Plantago, L., var. Americanum, Gray.** Leaves long-petioled, ovate, oblong, or lanceolate, pointed, mostly rounded or heart-shaped at the base, 3 to 9-nerved: carpels obliquely obovate, forming an obtusely triangular whorl in fruit. — From the base of the mountains eastward across the continent; also from California to Washington.

2. **SAGITTARIA, L.** ARROW-HEAD.

Staminate flowers above. Petals usually conspicuous. Stamens numerous, rarely few. Ovaries crowded in globose heads. Akenes abruptly beaked by the very short style. — Stoloniferous herbs with milky juice, broadly sheathing leaves often without a blade, and mostly simple stems bearing one to few whorls of flowers usually in threes.

1. **S. variabilis, Engelm.** Rootstock tuberiferous: scape $\frac{1}{2}$ to 2 feet high or more, angled: leaves very variable, ovate-sagittate, or more or less narrowed, or even linear, acute, the similar lobes more or less divergent, acuminate: petals white, rounded, exceeding the sepals: fruiting heads nearly half an inch in diameter: akenes obovate, with a conspicuous acute horizontal beak at the upper angle. — From the mountains eastward across the continent; also from Nevada and California to British Columbia.

ORDER 86. **NAIADACEÆ.** (PONDWEED FAMILY.)

Marsh or mostly immersed aquatic herbs, with stems jointed and leafy (naked and scape-like in *Triglochin*), leaves sheathing at base or stipulate, and flowers perfect or unisexual, often spathaceous, with or without perianth; ovaries 1-celled, 1-ovuled.

* Immersed aquatics with flat leaves : ovaries 4, distinct. — NAIADACEÆ.

1. **Zanichellia**. Flowers monœcious, axillary. Stamen 1, with slender filament. Fertile flowers solitary, with a cup-shaped membranous spathe or perianth. Ovaries nearly sessile, becoming more or less stipitate : stignas peltate. Leaves opposite.
2. **Potamogeton**. Flowers perfect, with herbaceous 4-sepaled perianth, in a peduncled spike. Anthers 4, sessile. Ovaries sessile : stigma sessile, unilateral. Leaves mostly alternate.

* * Marsh plants with terete bladeless leaves : flowers perfect, spicate or racemose, with herbaceous 6-lobed perianth : carpels more or less united, separating at maturity. — JUNCAGINÆÆ.

3. **Triglochin**. Ovaries 3 to 6, united until maturity. Leaves radical. Flowers bractless, in a spike-like raceme terminating a jointless scape.
4. **Scheuchzeria**. Ovaries 3, nearly distinct, at length divergent. Flowers bracteate in a loose raceme upon a leafy stem.

1. ZANICHELLIA, Michx. HORNED PONDWEED.

Flowers sessile or nearly so. Male flowers of a single naked stamen. Fertile flowers usually in the same axils. Fruit an obliquely oblong beaked nutlet — Very slender and branching, with very narrow and filiform leaves, not sheathing and with small stipules.

1. **Z. palustris**, L. Stems 2 inches to 2 feet long or more, leafy : leaves $\frac{1}{2}$ to 3 inches long : fruit somewhat incurved, often more or less toothed on the back. — From New Mexico and S. Colorado northward, and in both the Pacific and Atlantic States. In fresh-water ponds and slow streams.

2. POTAMOGETON, Tourn. PONDWEED.

The four stamens opposite the perianth segments. Fruit somewhat compressed, ovate, drupe-like, with a crustaceous nutlet within. — Slender, jointed and branching, in fresh or brackish water, with linear or dilated leaves, and scarious stipules : spikes enclosed in the bud, at length long-exserted.¹

* *Floating leaves more or less coriaceous, with a dilated petioled blade, different in form from the thinner submerged ones ; stipules free : spikes cylindrical, mostly dense, not interrupted.*

+ *Submerged leaves reduced to narrowly grass-like or filiform sessile phyllodia.*

1. **P. natans**, L. Stem rather stout, simple or sparingly branched : floating leaves thick, ovate-elliptic to lanceolate, acutish, slightly cordate at base, 21 to 29-nerved, mostly shorter than the petiole ; stipules long and conspicuous ; upper submerged leaves with a small lanceolate blade, the lower (formed early or late in the season) reduced to phyllodia : peduncle stout, bearing an emersed spike : fruit turgid, obliquely obovate, acute : nutlet with a small deep pit on each side. — Across the continent, in ponds and ditches. In deeper or flowing water, the plant becomes more slender and often submerged.

+ + *Submerged leaves lanceolate, rarely oval or linear.*

2. **P. rufescens**, Schrad. Floating leaves (often wanting) rather thin, 11 to 17-nerved, narrowly oblong-elliptic or oblanceolate, acutish, attenuate into

¹ Mature fruit is necessary for positive determination.

a very broad short petiole: submerged leaves as large as the floating ones, sessile or nearly so, narrowly oblong-lanceolate, obtuse or acute: spikes rather slender, on stout often elongated peduncles. fruit round-obovate, acutely margined, beaked by the rather long style: nutlet pitted on each side. — In Colorado and Montana, and common in the Atlantic States; also collected sparingly in California. In streams or ponds.

3. **P. lonchites**, Tuckerman. Stem rather slender, branching: floating leaves thickish, 11 to 23-nerved, long elliptical to oblong-lanceolate, acute or acutish, rather abruptly narrowed into a petiole usually longer than the blade; submerged leaves thinner and longer, mostly linear-lanceolate, more attenuate at base, the lower sessile: spikes on stout peduncles: fruit obliquely obovate, carinate, acute: nutlet somewhat 3-keeled, the sides scarcely impressed. — Am. Jour. Sci. 11. vi. 226. From Mexico to the Atlantic States; also in the Pacific States. Usually in streams.

4. **P. amplifolius**, Tuckerman. Stems often stout, simple: floating leaves (sometimes wanting) 30 to 50-nerved, elliptic to oblong-lanceolate, acute, mostly rounded or slightly cordate at base, on stout petioles about equalling the blade; submerged leaves often very large, mostly falcate and somewhat undulate, acute, attenuate to a usually short petiole: spike thick, on a very stout peduncle: fruit large, 3-keeled, with a broad stout beak: sides of the nutlet not pitted. — Am. Jour. Sci. loc. cit. 225. — From New Mexico to the Atlantic States; also in California and Oregon. In ponds and streams.

5. **P. gramineus**, L. Stems very slender, branching: floating leaves rather thin, 9 to 15-nerved, small, oblong-elliptic, acutish, rounded or cuneate at base, on slender petioles mostly equalling or exceeding the blade; submerged leaves linear-lanceolate, variable in length, more commonly short, acute or acuminate, narrowed at base: spikes rather loose, on stout often elongated peduncles: fruit round-obovate, acute, scarcely keeled. — From the Yellowstone eastward; also in Nevada and California. In still or flowing water.

* * Leaves all submerged and uniform, thin and dilated (lanceolate to oval), numerous, mostly sessile: spikes dense, on stout peduncles.

6. **P. lucens**, L. Stem stout, branching: leaves usually large (2 to 6 inches long), oblong-lanceolate or oblanceolate, abruptly acute or acuminate, often undulate-serrate, narrowed at base to a short petiole or subsessile; stipules large: peduncles often elongated: fruit acute, slightly keeled. — From New Mexico to California; also eastward to Florida and New England.

7. **P. perfoliatus**, L. Stem more slender, flexuous, branching: leaves broadly cordate to cordate-lanceolate, $\frac{1}{2}$ to $1\frac{1}{2}$ inches long, obtuse or acute, clasping at base; stipules small: spikes somewhat compound, on mostly short peduncles: fruit obtusely keeled, beaked by the short slender style.

Var. (?) **lanceolatus**, Robbins. Leaves longer (2 to 4 inches or more), and more lanceolate, acuminate, undulate: peduncles thickened upward: fruit nearly orbicular. — Gray's Manual, 488.

* * * Leaves all submerged and uniform, narrowly linear or setaceous, sessile.

← Stipules free from the narrow base of the leaf.

8. **P. pusillus**, L. Stem filiform: leaves 1 or 2 inches long, rarely a line wide, often nearly setaceous, 1 to 5-nerved, biglandular at base: spikes capitate, or elongated, or interrupted, on slender flattened peduncles.

Var. **vulgaris**, Fries. Leaves 3-nerved, often obtuse, revolute and hence subulate. — From the Uintas to the N. Atlantic States and Canada.

+ + *Stipules united with the sheathing base of the leaf: spikes interrupted.*

9. **P. pectinatus**, L. *Stem filiform, repeatedly branched: leaves very narrowly linear, 2 to 6 inches long, rarely over $\frac{1}{2}$ line broad, often setaceous, 1-nerved, acute: peduncles elongated, slender: fruit in often dense verticils, large (2 lines long), obliquely obovate, obtusely keeled.* — From the Rocky Mountains eastward across the continent; also in the Pacific States.

10. **P. marinus**, L. Resembling narrow-leaved forms of the last, *low and very leafy: peduncles much elongated: fruit much smaller (a line long) and thinner, round obovate, not keeled upon the rounded back, tipped with the broad sessile stigma.*

Var. (?) **occidentalis**, Robbins. *Often taller and less leafy: peduncles usually rather short: spikes interrupted.* — Bot. King Exped. 339. Colorado, Utah, Montana, and westward.

11. **P. Robbinsii**, Oakes. *Stem rather stout, often branched and flexuous: leaves numerous, distichous, the close sheaths nearly covering the stem, linear-lanceolate, 2 to 3 inches long by 2 lines broad, many-nerved, acuminate, ciliate-serrulate: spikes usually several, on rather stout pedicels: fruit oblong-obovate, nearly 2 lines long, keeled with a broadish wing, acutely beaked* — Gray's Manual, 490. From Oregon to the Yellowstone, and common in the N. Atlantic States.

3. TRIGLOCHIN, L. ARROW-GRASS.

Stamens 3 or 6: anthers nearly sessile. Ovary with sessile stigmas and solitary ovules, separating at maturity from the central axis into as many distinct pods. — Herb with fibrous roots.

1. **T. maritimum**, L. *Rather stout, a span to 2 or 3 feet high: leaves shorter than the scape, a line or two broad: raceme usually crowded, 4 to 12 inches long: flowers a line broad: fruit obtuse at base, 6-carpelled, $1\frac{1}{2}$ to $2\frac{1}{2}$ lines long, and about equalling the pedicels.* — In saline places across the continent.

2. **T. palustre**, L. *Slender, $\frac{1}{2}$ to $1\frac{1}{2}$ feet high: leaves less than a line broad: flowers smaller: fruit attenuate at base, 3-carpelled, $2\frac{1}{2}$ to 4 lines long, exceeding the pedicels, separating from below upward.* — From the Rocky Mountains eastward across the continent.

4. SCHEUCHZERIA, L.

Stamens 6: anthers on slender exerted filaments. Ovary of 3 nearly distinct carpels becoming divergent coriaceous sub-globose pods: stigmas flat and sessile. — Herb with a creeping jointed scariosously sheathed rootstock.

1. **S. palustris**, L. *Stems a span high or less: leaves exceeding them, pitted at the tip: raceme 4 to 6-flowered, with sheathing bracts, the upper ones small.* — From the Rocky Mountains eastward across the continent; also in California and Washington.

ORDER 87. **CYPERACEÆ.** (SEDGE FAMILY.)

Grass-like or rush-like herbs, with fibrous roots, mostly solid stems, closed sheaths, and spiked chiefly 3-androus flowers, one in the axil of each of the glume-like imbricated bracts, destitute of any perianth, or with hypogynous bristles or scales in its place, the 1-celled ovary in fruit forming an akene. Style 2 or 3-cleft. Stem leaves when present 3-ranked.

* Flowers all perfect: spikelets few to many-flowered, solitary or spicate, the spikes capitate or umbellate: only 1 or 2 of the lower scales usually empty. — **SCIRPINEÆ.**

← Spikelets more or less flattened, the scales being in 2 ranks: inflorescence involucrate. — **CYPEREÆ.**

1. **Cyperus.** Perianth (bristles, etc.) none. Style slender, deciduous. Spikelets spicate or clustered. Stamens 1 to 3.

← ← Spikelets many-flowered, not flattened, the scales imbricated all around. — **SCIRPEÆ.**

++ Style not dilated at base.

2. **Scirpus.** Spikelets solitary or clustered or in a compound umbel, the stem often leafy at base and inflorescence involucrate. Style deciduous or only the base persistent. Barbed bristles present at the base of the akene or wanting. Stamens mostly 3.

3. **Eriophorum.** Like the last, but the numerous naked bristles long-exserted and silky in fruit. Spikelets few. Stamens 1 to 3.

4. **Hemicarpha.** Like *Scirpus*, but without bristles and with a minute hyaline bractlet between each flower and the rhachis. Spikelets solitary or few in a sessile apparently lateral cluster. Stamen 1.

++ ++ Style enlarged at base.

5. **Eleocharis.** Spikelet solitary, terminal upon a leafless bractless stem. Base of the style persistent. Bristles usually present. Stamens 3.

6. **Fimbristylis.** Spikelets in an involucrate umbel. Stem leafy at base. Style usually wholly deciduous. Bristles none. Stamens 1 to 3.

** Flowers monœcious; the staminate and pistillate in the same spike, which is terminal (in ours): akene naked, without bristles. — **SCLERINEÆ.**

7. **Kobresia.** Spikelets sessile in a terminal spike, with a glume-like bract under each spikelet. Stem leafy at base. Base of the style persistent. Stamens 3.

*** Flowers monœcious, in the same or distinct spikelets, or diœcious: akene enclosed in an inflated sac-like persistent perigynium. — **CARCINEÆ.**

8. **Carex.** Spikelets solitary, spicate or paniculate. Hypogynous bristles or scales wholly wanting or a single short bristle at the base of the ovary.

1. **CYPERUS, L.** GALINGALE.

Scales concave or keeled, often decurrent upon the rhachis. Akene lenticular or triangular, not beaked, usually smooth. — With mostly triangular and nearly naked simple stems, sheathed at base by the nearly radical leaves: inflorescence subtended by a mostly conspicuous leafy involucre, usually irregularly umbellate with unequal rays, the spikelets in spikes solitary or clustered upon the rays, the central spike or cluster always sessile, and the whole often contracted into a single more or less dense head. Ours all belong to **EUCYPERUS**, in which the style is 3-cleft and akene triangular, the spikelets many-flowered, with carinate scales, and with the rhachis naked or nearly so.

* *Stamen 1: spikes short and small, collected in globular heads, ovate or linear-oblong, compactly many-flowered: low annuals, with a 2 to 3-leaved involucre.*

1. *C. aristatus*, Rottb. Spikes oblong becoming linear, 7 to 13-flowered, in 1 to 5 ovate heads: scales nerved, tapering into a long recurved point: akene obovate, obtuse. — *C. inflexus*, Muhl. Said to be sweet-scented in drying. Across the continent.

* * *Stamens 3: spikes loosely or somewhat remotely 6 to 12-flowered, flattish and greenish, several crowded together in one sessile or in a few peduncled heads or dense clusters: scales convex on the back, many-nerved, a little longer than the sharply triangular akene: perennials, with hard clustered corms or bulb-like tubers, at the base of the stems.*

2. *C. Schweinitzii*, Torr. Stem rough on the angles, 1 to 2 feet high: leaves linear: umbel simple, 4 to 8-rayed: spikes crowded along the upper part of the mostly elongated rays, erect: scales awl-pointed: joints of the axis narrowly-winged. — In dry sandy places in Colorado; also from Lake Ontario northwestward.

3. *C. filiculmis*, Vahl. Stem slender, wiry, often reclined: leaves linear: spikes numerous and clustered in one sessile dense head, or in 1 to 7 additional looser heads on spreading rays of an irregular umbel: joints of the axis naked: scales blunt, greenish. — In dry soil, and coming into our range from W Kansas.

2. SCIRPUS, L. BULRUSH OR CLUB-RUSH.

Hypogynous bristles 3 to 6, barbed or ciliate, or wanting. Style 2 to 3-cleft. Akene lenticular or more or less triangular, obovoid. — Tufted plants, with creeping rootstocks, the stem sheathed or leafy at base, and the spikelets in an apparently lateral cluster, or compound umbel-like panicle, or solitary.

* *Bristles when present rigid, not elongated and contorted or exerted after flowering, barbed downwards or smooth.*

+ *Spike solitary, few-flowered, small, often flattish: akene triangular, smooth.*

1. *S. cæspitosus*, L. Stems terete, filiform, in compact turfy tufts, densely sheathed at the base, the upper sheath bearing a very short awl-shaped leaf: scales of the ovoid spike rust-colored: involucreal bract a rigid-pointed scale, resembling the lowest proper scale of the spike: bristles 6, smooth, longer than the abruptly short-pointed akene. — Mountains of Colorado (*Hall and Harbour*); also from the mountains of New England and N. Carolina northwestward.

+ + *Spikes clustered (rarely only one), appearing lateral from the one-leaved involucre, which resembles the naked stem, seeming to be a continuation of it.*

++ *Stem sharply triangular, stout: sheaths at base more or less leaf-bearing: spikes rusty brown, closely sessile in one cluster.*

2. *S. pungens*, Vahl. Stem sharply 3-angled throughout, 1 to 4 feet high, with concave sides: leaves 1 to 3 elongated: spikes 1 to 6, capitate, usually long overtopped by the pointed involucreal leaf: scales ovate, sparingly ciliate, 2-cleft at the apex and awl-pointed from between the acute lobes: anthers tipped with an awl-shaped minutely fringed appendage. — Borders of ponds and streams from California into Mexico, and northward; common in the Atlantic States.

3. **S. Olneyi**, Gray. Stem 3-wing-angled, with deeply excavated sides, 2 to 7 feet high, the upper sheath bearing a short triangular leaf or none: spikes 6 to 12, closely capitate, overtopped by the short involucre leaf: scales orbicular, smooth, mucronate-pointed: anthers with a very short and blunt minutely bearded tip.—Pl. Lindh. 30. Across the southern part of the continent and northward along the Atlantic seaboard.

++ Stem terete, very tall and stout, naked: sheaths at the base bearing a short and imperfect leaf or none: spikes rusty or chestnut-brown, numerous and clustered in a one-sided compound umbel-like panicle, the principal rays of which mostly surpass the involucre leaf: scales with a salient midrib extending into a mucronate point.

4. **S. lacustris**, L. Stem 3 to 9 feet high, scales ciliate: akene pale and dull, obovate with a narrowed base, usually overtopped by the 4 to 6 slender downwardly barbed bristles.—*S. validus*, Vahl. Common in fresh-water ponds throughout the Atlantic States, and extending westward to the mountains.

Var. **occidentalis**, Watson. Scales often pubescent, especially on the midvein, usually pale with fine brown lines: bristles not exserted: akene broadly obovate, terminating abruptly in a rather short beak.—Bot. Calif. ii. 218. From Texas and Colorado to British Columbia and the Pacific coast. Known as "Tule."

+ + + Spikes clustered in simple or mostly compound umbellate or cymose-panicled clusters, many-flowered, terete: involucre of mostly several obvious and flat leaves: stems tall, triangular, leafy.

++ Spikes large: midrib of the scales extended beyond the mostly lacerate or 2-cleft apex into a distinct awn.

5. **S. maritimus**, L. Leaves flat, linear, as long as the stout stem (1 to 3 feet high), those of the involucre 1 to 4, very unequal: spikes few to several in a sessile cluster, often also with 1 to 4 unequal rays: awns of the scale soon recurved: akene obovate-orbicular, compressed, flat on one side, convex or obtuse-angled on the other, minutely pointed, shining, longer than the bristles.—In salt marshes everywhere across the continent.

6. **S. fluviatilis**, Gray. Stem stouter and taller: leaves flat, broadly linear, the upper and those of the very long involucre much exceeding the compound umbel: rays 5 to 9, elongated, recurved-spreading: scales less lacerate and their awns less recurved: akene obovate, sharply and exactly triangular, conspicuously pointed, dull, scarcely equalling the bristles.—Borders of lakes and streams from W. Vermont to Illinois and Wisconsin, and extending into our range at its northeastern border.

++ ++ Spikes very numerous, small: scales mucronate-pointed or blunt: umbel-like cymose panicle irregular, compound or decompound: stem tall and very leafy: bristles very slender and often more or less tortuous and naked below.

7. **S. sylvaticus**, L. Spikes lead-colored, 3 to 10 in a cluster at the end of the mostly slender ultimate divisions of the open decompound panicle: scales bluish: bristles 6 and downwardly barbed throughout: akene angled on the back, short-pointed: style 3-cleft.

Var. **digynus**, Boeck. *Style 2-cleft, akene not at all angled on the back, stamens 2, and bristles 4.* — *S. microcarpus*, Presl, of Gray's Manual. From California to Colorado and across the continent northward. The type is rarely collected in New England.

8. **S. atrovirens**, Muhl. Very similar to the last: *panicle more contracted, the smaller spikelets crowded in denser and larger clusters: scales narrower and narrowly acuminate: bristles scarcely barbed below the middle: style 3-cleft: akene oblong-obovate, more acuminate, slightly angled on the back.* — In wet meadows and bogs from Colorado to California and Oregon, and eastward to New England.

* * *Bristles capillary, naked, not barbed, elongating, becoming tortuous and entangled, much longer than the triangular akene.*

9. **S. lineatus**, Michx. Stem triangular, leafy, 1 to 3 feet high: leaves linear, flat: umbels terminal and sometimes axillary, loose, drooping, the terminal with a 1 to 3-leaved involucre much shorter than the long slender rays: spikes oblong, becoming cylindrical, on filiform drooping pedicels: bristles at maturity scarcely exceeding the green-keeled and pointed scales: akene sharp-pointed. — From New England to Wisconsin and southward, coming into our range from W. Kansas.

3. ERIOPHORUM, L. COTTON-GRASS.

Distinguished from *Scirpus* chiefly by very numerous naked silky bristles which become long-exserted in fruit. Style very slender and elongated, 3-cleft. Akene acutely triangular. — Perennials with creeping rootstocks.

1. **E. gracile**, Koch. Stem very slender, 1 or 2 feet high: *leaves slender, channelled-triangular: involucre of 1 to 3 brownish scales: spikelets 2 to 5 on short tomentose-scabrous slightly nodding rays: akene linear-oblong, broadest above.* — Cold bogs across the continent in the northern tier of States.

2. **E. polystachyum**, L. Stouter: *leaves linear, flat or barely channelled below: involucre more conspicuous, 2 or 3-leaved: spikelets more numerous and larger, upon longer nodding usually smooth rays: akene broader, obovate.* — From Colorado northward, and thence eastward across the continent; also in Oregon.

4. HEMICARPHA, Nees.

Distinguished from *Scirpus* chiefly by the minute hyaline bractlet between the flower and the axis. Style 2-cleft. — Low setaceous annuals, with flattened stems, somewhat leafy at base.

1. **H. subsquarrosa**, Nees. Stems numerous, tufted, 1 to 6 inches high, brown-sheathed at base, with 1 or 2 very short filiform leaves: principal involucre bract continuous with the stem, the others much smaller or none: scales brown, tipped with a short recurved point. — From California to New Mexico and Colorado and eastward through the Atlantic States.

5. ELEOCHARIS, R. Brown. SPIKE-RUSH.

Scales closely imbricated all around the rhachis. Perianth of 3 to 9 short retrorsely barbed bristles, rarely none. Style usually 3-cleft, the conical or

flattened tuberculate base persistent and mostly jointed upon the summit of the turgid-triangular or lenticular akene.—Stems tufted, from matted or creeping rootstocks, terete or angular, the base covered with closely appressed sheaths: lower scale of the spikelet sometimes enlarged and bract-like.

* *Spike small and few-flowered, the scales somewhat distichous or only 3-ranked: style 3-cleft and akene triangular.*

+ *Tubercle contracted at its junction with the akene.*

1. **E. acicularis**, R. Br. Stems with fibrous roots and very slender running rootstocks, usually setaceous, 1 to 8 inches high: spike 3 to 9-flowered: scales acutish, more or less deeply tinged with brown: bristles 3 or 4, often wanting: akene oblong-obovate, obscurely triangular and faintly ribbed on the sides; tubercle broad, short and blunt.—On sandy or muddy stream-banks across the continent.

+ + *Tubercle continuous with the akene and not contracted at base.*

2. **E. pauciflora**, Watson. Stems from slender running rootstocks, 3 to 8 inches high, striate: spike ovate-oblong: scales acute, dark brown: bristles 3 to 6, usually equalling the akene: akene oblong-obovate, obtusely triangular; tubercle rather stout, pyramidal, nearly a third as long as the akene.—Bot. Calif. ii. 221. *Scirpus pauciflorus*, Lightfoot, Gray's Manual, 560. From Colorado and Wyoming to the N. Atlantic States; also in California.

* * *Spike terete, many-flowered: tubercle somewhat contracted at its junction with the akene: style 2-cleft and akene lenticular.*

3. **E. palustris**, R. Br. Stems usually slender, terete, striate, $\frac{1}{2}$ to 4 feet high: spike ob'ong-lanceolate to linear, acute, 3 to 12 lines long: scales obtuse or the upper acutish, thin, brown with white margin and greenish keel: bristles 4, about equalling the akene: akene obovate, turgid, smooth; tubercle broad-deltoid, acutish or acute, rarely acuminate.—Throughout the continent, and in most parts of the Old World.

4. **E. olivacea**, Torr. Stems very slender and spreading, 1 to 6 inches high: spike ovate or oblong-ovate, 1 to 3 lines long: scales obtuse, rather loosely imbricated, purple with a green midrib: bristles 6 or 8, longer than the akene: akene and tubercle as in the last.—Colorado, Montana, and Oregon; also on the Great Lakes and the Atlantic coast.

5. **E. compressa**, Sulliv. Stem flat, striate, 1 to 2 feet high: spike ovate-oblong, at length lanceolate, 4 to 7 lines long: scales acute, dark purple with broad white pellucid margins: bristles 1 to 4 (or none), very slender and fragile, shorter than or equalling the akene: akene obovate-pear-shaped, compressed; tubercle small, conical, pointed.—Gray's Manual, 558.

6. FIMBRISTYLIS, Vahl.

Scales closely imbricated around the rhachis. Styles 2 to 3-cleft, often flattened and ciliate, somewhat dilated at base. Akene lenticular or triangular, usually attenuate at base or substipitate.—In ours the style is 2-cleft and the akene lenticular.

1. **F. spadicea**, Vahl. Stems 1 to 2 $\frac{1}{2}$ feet high, from a perennial root, rigid, as are the filiform convolute-channelled leaves: spikes ovate-oblong, becom-

ing cylindrical: *stamens* 2 or 3: *akene very minutely striate and obscurely reticulated*.—Colorado to Indian Territory and Texas; also along the Atlantic coast.

7. KOBRESIA, Willd.

Lowest glume enclosing an ovary with a long trifold style; the next one, or rarely the next two, enclosing 3 stamens; often a rudimentary glume or awn terminating the rhachis; occasionally but one glume to a spikelet.—Perennial herbs with filiform leaves, radical or sheathing the stems at base.

1. **K. scirpina**, Willd. Stems cespitose, 5 to 12 inches high, striate-angled: leaves shorter than the stem: spikelets few, small, and brown, in a somewhat clavate spike one inch long.—*Elyna spicata*, Schrad. South Park, Colorado (*Hall & Harbour*).

8. CAREX, L. SEDGE. (By L. H. BAILEY, JR.)

Flowers in spikes, imperfect, the staminate and pistillate in different parts of the same spike (spike *androgynous*), or in separate spikes on the same culm (plant *monœcious*), or rarely on entirely distinct plants (plants *diœcious*). Staminate flower composed of 3 stamens borne beneath a bract or *scale*. Pistillate flower composed of a single pistil bearing 2 or 3 exserted styles, forming in fruit a lenticular or triangular acheneum which is enclosed in a more or less inflated sac (*perigynium*) borne in the axil of a scale.—Perennial grass-like herbs with 3-ranked leaves, mostly triangular culms, and spikes in the axils or exserted from the sheaths of leaf-like or scale-like bracts. Theoretically each flower is entirely destitute of floral envelopes, and borne on a branch which springs from the axil of a scarious bract (the *scale* of the following descriptions), the enclosing perigynium of the fertile flowers answering to one (or two) connate bractlet. The term *fruit* as applied to the perigynium and its contents is a misnomer. In the subgenus *Vignea* of the present elaboration the spikelets or spiculae of authors are called *spikes*, which they truly are, and they are conglomerated into *heads*. The genus is an exceedingly critical one and its study should not be attempted with unripe or imperfect specimens.

Artificial Key.

- I. Spike one, terminal, strictly simple, staminate at the top, or in diœcious plants (5 & 46)
all staminate or all pistillate.

Stigmas three.

Perigynium spindle-shaped or lanceolate,

- | | |
|--------------------------------|------|
| Green | 1 |
| Dark brown or purple | 2, 3 |

Perigynium short, mostly ovate or elliptic,

Perfectly smooth.

Perigynia 1 to 3, conspicuously spreading, or remote from the staminate portion,

- | | |
|------------------------------------|----|
| Obovate, obtuse | 10 |
| Elliptic, sharply beaked | 16 |

Perigynia several, continuous with the staminate portion.

- | | |
|---------------------------------|----|
| Scales leaf-like | 11 |
| Scales short, ciliate | 40 |
| Scales short, entire, | |

Very broad, covering the perigynium.	
Leaves short, stiff, involute	15
Leaves ordinary	14
Narrower, shorter than perigynium	17
Scabrous or hairy.	
Perigynia 1 to 4, scabrous above	4
Perigynia several to many, hairy	5
Stigmas two	52, 53

II. Spikes all aggregated into a round or ovoid uninterrupted head, stigmas two.

Spikes densely packed, the individual ones scarcely discernible.

Head black	50 var. <i>nigra</i> .
Head tawny or brown,	
Subtended by 1 or 2 long leafy bracts	80
Naked or nearly so.	
Perigynium nearly orbicular, dark	70
Perigynium ovate or lanceolate.	
Spikes staminate at base	78, 79
Spikes staminate at top.	
Perigynium rough-angled	58, 59
Perigynium smooth	60, 61, 62
Head green	58

Spikes simply aggregated, the individual ones readily recognized.

Spikes nearly linear, light colored	71
Spikes oval or ovoid.	
Perigynium wing-margined,	
Broadly ovate or oval	84, 87
Lanceolate	82, 83, 85
Perigynium wingless,	
Nerved, beak longer than the body	64
Nerved, beak short	57
Nerveless.	
Heads small globular	62
Heads oblong	76

III. Some or all the spikes distinct.

Terminal spike staminate above (staminate flowers inconspicuous), spikes often all approximated into an interrupted head or panicle, stigmas always two.

Spikes conspicuously paniced	65, 64 (sometimes).
Spikes not paniced.	
Perigynium strongly nerved.	
Culm flat	63
Culm broadly 3-angled	64
Culm nearly terete	57
Perigynium nerveless or nearly so.	
Spikes 1 to 3-flowered, scattered; perigynium erect; plants delicate	54
Spikes 5 to many-flowered; perigynium divaricate or reflexed.	
Spikes all distinct	55
Upper spikes aggregated	66
Spikes 5 to 12-flowered; perigynium nearly upright	59

Terminal spike staminate below.

Stigmas two.	
Spikes very dark.	
Scales long and sharp	49
Scales ordinary	50, 51
Spikes tawny or whitish.	
Perigynium lanceolate.	
Thin and scale-like	81, 82, 83

More or less thick and rounded.	
Heads fulvous	85
Heads silvery or silvery-tawny	72, 73, 74
Perigynium ovate, wing-margined	86, 87
Perigynium ovate, not margined	75, 76, 77
Perigynium broadly obovate, nearly pointless	22
Stigmas three.	
Pistillate spikes nodding	25
Pistillate spikes erect	23, 24
Intermediate spikes of the silvery or tawny interrupted head staminate, stigmas two.	
Perigynium short and broad, dark-colored	68
Perigynium ovate or ovate-lanceolate, straw-colored	67, 69
Perigynium long-lanceolate, silvery-green	72
Terminal spike or spikes entirely staminate.	
Stigmas two.	
Perigynium strongly nerved.	
Plant stout	40
Plant very slender	45 var. <i>juncella</i> .
Perigynium nerveless or nearly so.	
Bracts all leaf-like,	
Scales ciliate at top	41
Scales not ciliate	42
Bracts not conspicuously leafy.	
Spikes rounded or oval.	
Staminate spike short-stalked	35, 45 var. 2
Staminate spike sessile	47, 50
Spikes oblong or long-cylindrical.	
Perigynium ovate, green or brown-purple	43, 44, 45
Perigynium obovate, yellow or whitish	20
Stigmas three.	
Perigynium hairy.	
Pistillate spikes few-flowered, almost globular, mostly sessile.	
Scales ciliate	5
Scales not ciliate.	
Spikes greenish; culms slender	7, 8
Spikes greenish or whitish; culmus very short	8, 9
Spikes colored	6
Pistillate spikes few-flowered, linear; plant delicate	12
Pistillate spikes several to many-flowered, oblong or cylindrical.	
Perigynium conspicuously nerved	32
Perigynium nerveless or nearly so.	
Plant hairy throughout	13
Plant smooth	30
Perigynium smooth.	
Pistillate spikes pendulous or nodding.	
Beak slender, longer than body of perigynium; spikes greenish-white	29
Body of perigynium as long or longer than beak.	
Spikes small, 6 or less-flowered; plant delicate	27
Spikes nearly globular, pendulous, very dark	48
Spikes very loosely-flowered, long-linear	26
Spikes thick and long; perigynium inflated,	
Greenish straw-colored, slender-beaked, conspicuously more than 10-nerved	34
Straw-colored or often purplish,	
More or less ascending	36, 37
Conspicuously squarrose	38, 39
Spikes all erect,	
Short-oblong or round, densely-flowered, approximate.	
Beak short, bifid	31

Beak short, stout, truncate	18
Beak longer than body	29
Spikes cylindrical.	
Perigynium beakless	19
Perigynium nearly beakless, the point bent	21
Perigynium conspicuously beaked,	
Lanceolate, flattened	28
Greenish, very turgid below, large	33
Brown and hard, with spreading setaceous teeth	32 var.
Thin, inflated, straw-colored or purple,	
More or less ascending	36, 37
Conspicuously squarrose	38, 39

SUBGENUS I. Eucarex. Staminate flowers forming one or more terminal linear or club-shaped spikes which are often pistillate at base or apex, or occasionally having a few pistillate flowers intermixed. Pistillate flowers usually in distinct and normally simple mostly peduncled spikes which are seldom aggregated into heads. Cross-section of the perigynium circular or obtusely angular in outline. Style commonly 3-parted and the achenium trigonous or triquetrous. — Passing into the following subgenus through the members of the last section.

§ 1. *Spike single* (in our species), *androgynous, male at the top, the rhachis conspicuously jointed: perigynium lanceolate or spindle-shaped, longer than the scale, deflexed at maturity: stigmas very rarely two.* — **DEFLEXOCARPÆ.** Low and mostly slender species.

* *Perigynium green, linear-lanceolate, sessile, several times longer than the scale.* — **PAUCIFLORÆ, Tuckerm.**

1. **C. microglochin**, Wahl. Culms rigid from a creeping base, 2 to 8 inches high: leaves few and narrow, shorter than the culm: staminate flowers very few: perigynia 4 to 6, the orifice closed by a conspicuous projecting racheola which springs from the inside beneath the achenium: scales deciduous. — *Uncinia microglochin*, Ledeb. Colorado, probably from high mountains (*Hall & Harbour*, 607); also in subarctic America. (Eu.)

C. PAUCIFLORA, Lightf., distinguished by the orifice of the perigynium being closed with the stiff persistent style, occurs in British America and may be expected northward.

* * *Perigynium brown, spindle-shaped or narrowly ovate, stipitate, little longer than the scale.* — **PUBLICARES, Tuckerm.**

2. **C. Pyrenaica**, Wahl. Culm 2 to 8 inches high, slender: spike dense, oblong, brown or purple, the fertile flowers erect until full maturity: leaves narrow, mostly involute-filiform, shorter than the culms: staminate flowers few, occupying $\frac{1}{3}$ or less the length of the spike: perigynium few-nerved or nerveless, usually shining at maturity. — High mountains of Colorado, Utah, and northward. (Eu.)

3. **C. nigricans**, C. A. Meyer. *Stouter: leaves nearly flat, a line or more broad: staminate flowers usually conspicuous and occupying about half the spike: perigynium somewhat ventricose, dull: otherwise as in the last, with which it grows.* — Evidently the more common species. (Asia.)

§ 2. *Spikes one or more: staminate spike always single, usually distinct, sessile or nearly so, sometimes androgynous with all the pistillate flowers borne at its base: pistillate spikes, if any, small and globular, mostly sessile, more or less approximate: bracts short or none, sheathless: perigynium ovate or globular, hirsute (thin and scabrous in No. 4), tightly surrounding the achenium, usually bearing a beak half its length: pistillate scales acute (except in Nos. 4 and 5): stigmas rarely 2. — SPHERIDIOPHORÆ, Drejer. Low species in dry places, the leaves all radical. No. 5 is dioecious.*

* *Spike one, androgynous. — FILIFOLIÆ, Tuckerm.*

4. **C. filifolia**, Nutt. *Cespitose: culms slender, obtusely angled and smooth, 3 to 12 inches high, when full grown longer than the filiform rigid leaves, their bases surrounded by dry brown leafless sheaths which at length break up into fibres: spike $\frac{1}{2}$ to 1 inch long, ferruginous or whitish, bractless, the staminate portion sometimes nearly free from the pistillate portion: perigynium broadly triangular-obovoid, thin, few-nerved or nerveless, scabrous or slightly hairy above, abruptly contracted into a short, stout, white-hyaline entire beak, about the length or shorter than the very broad hyaline-margined clasping scale: perigynium containing a short serrate racheola, whence the name *Uncinia breviseta*, Torr. — Dry plains and mountains from Colorado westward and northward.*

Var. **valida**, Olney. *Culm very stout, a foot high, rigid, sharply angled, much longer than the long-pointed broader leaves: spike longer, often subtended by a hispid bract: perigynium more glabrous. — C. filifolia, var., Boott in Gray's Rocky Mountain Plants, 77. Colorado.*

5. **C. scirpoidea**, Michx. *Creeping: culms in flower short, elongating (6 to 16 inches high) in fruit and exceeding the broad and flat leaves, more or less scabrous on the angles at least above, the basal sheaths not splitting into fibres: spike ferruginous, linear or club-shaped, $\frac{1}{2}$ to 2 inches long, occasionally with 1 or 2 accessory spikes at base: perigynium ovate or obovate, hairy, lightly nerved, about the length (or a little longer) of the ciliate more or less obtuse scale: scales on the staminate plant hyaline-margined, not ciliate. — C. Wormskioldiana, Hornem. High mountains, Colorado and Utah, northward and westward. (Asia, Norway.)*

* * *Spikes two to several, the lower occasionally peduncled or sometimes radical: perigynium contracted below, usually bearing two prominent ribs, the very short or often prolonged beak slightly 2-toothed. — MONTANÆ, Fries (in part).*

+ *Culms upright, as long or longer than the leaves: spikes closely flowered, mostly aggregated at the top of the culm.*

6. **C. Pennsylvanica**, Lam. *Extensively creeping: culms few, slender, 4 to 10 inches high: staminate spike conspicuous, $\frac{1}{2}$ to 1 inch long, often club-shaped, sessile or shortly peduncled, sometimes pistillate at the top: pistillate spikes 1 to 4, the lower one very rarely an inch remote, the upper ones bractless, the lower sometimes subtended by a short and subulate brown bract: perigynium globose or roundish-obovoid, abruptly contracted into a short or often long beak, usually shorter than the acute or cuspidate brown or rarely whitish scale. — C. leucom, Willd., is a form with long beaks. Dry sandy plains about Denver (E. L. Greene), Ute Pass, Col. (T. C. Porter); Fort Pierre,*

S. Dak., and probably generally distributed northward. A variable species; spikes usually brown or dark purple, sometimes whitish, the pistillate varying in size from an inch long to very small and almost abortive. A form with rigid leaves, a single whitish pistillate spike with large perigynia and borne at the base of the staminate spike, has considerable resemblance to forms of *C. filifolia*. Radical spikes sometimes occur.

7. *C. Emmonsii*, Dew. *Densely caespitose: culms many, very slender, about equalling the narrow soft leaves: staminate spike very small, 1 to 4 lines long, often nearly concealed by the pistillate spikes, which are 2 to 5, small, 3 to 9-flowered, green, the lower usually short-bracted, very closely aggregated at the top of the culm, occasionally 1 or 2 of the lower a little remote or rarely on a radical peduncle: perigynium small, narrowly oval or ovate and more or less 3-sided, with a conspicuous more or less toothed beak.* — *C. Novæ-Angliæ*, var. *Emmonsii*, Carey. Indian Territory (*Geo. D. Butler*) and southward. Readily distinguished by its closely aggregated green spikes.

+ + *Culms mostly shorter than the leaves: spikes looser flowered and more scattered, often radical.*

8. *C. Novæ-Angliæ*, Schw., var. *Rossii*, Bailey. *Culms few, 3 to 6 inches high, nearly or about the length of the narrow and straight leaves: pistillate spikes few, 1 to 4-flowered, linear and upright, light colored: perigynia loosely alternate on a zigzag rhachis, ovoid, the flattened mostly cut toothed beak either longer or shorter than the body.* — *C. Rossii*, Boott. Frequent from New Mexico (*Fendler*, 889) to the mountains of Colorado and Utah; also in British Columbia. The species occurs in Washington and northward and eastward in British America. It is distinguished by a weaker habit, and darker colored and more aggregated spikes.

9. *C. umbellata*, Schk. *Rootstock stout, mostly horizontal: culms many, mostly very short and crowded and concealed among the leaves, sometimes 3 to 4 inches long: leaves many, generally short, stiff and curved, sometimes weak and straggling and 6 inches long: staminate spike $\frac{1}{2}$ inch or less long, not usually distinct and conspicuous: pistillate spike usually crowded among the bases of the leaves, sometimes one or more of them exserted and clustered with the staminate spike: perigynium globose-elliptic, more or less flattened, produced into a flattened toothed beak as long as the body.* — Indian Territory; and common eastward.

Var. *brevirostris*, Boott. Beak much shorter and minutely toothed, the perigynium rounder or somewhat 3-sided. — Mogollon Mountains, New Mexico, and near Golden City, Colorado (*E. L. Greene*); also in California and British America.

§ 3. *Spikes androgynous, staminate above: pistillate flowers few, often remote, usually on a more or less zigzag rhachis: scales prolonged and leaf-like (scarious and often short in No. 10): perigynium smooth, or slightly hispid above, mostly tightly enclosing the achenium, the beak, if any, straight.* — *PHYLLOSTACHYS*,¹ Carey.

¹ A peculiar section, including one Caucasian and five American species which fall into two well-marked groups. The section is connected with the *Montanæ* through the *Bracteata*, and with the Old World *Depauperata*, and through that group with the *Lucifloræ*, by *C. Geyeri*.

* *Culms all as long or nearly as long as the leaves: staminate flowers conspicuous: pistillate flowers very few and large: beak very short.* — **PHYLLOSTACHYÆ**, Bailey.

10. **C. Geyeri**, Boott. Stoloniferous: culms very slender, angled, rough, about a foot high, about the length of the flat rough-edged leaves: staminate portion of the spike usually appearing distinct, $\frac{1}{2}$ to 1 inch long: pistillate flowers 1 or 2, large, erect with the rhachis: perigynium triangular-obovoid, 3 lines long, the conspicuous angles obtuse, one-nerved on the two inner sides, very smooth, with a very short entire erose and hyaline beak: scales thin and brown, acute, 2 to 4 times the length of the perigynium. — Mountains of Colorado, Utah, and Montana. Hitherto confounded with *C. multicaulis*, Bailey, a Californian and Oregon species with numerous prolonged stiff terete and smooth culms.

* * *Culms mostly much shorter than the leaves: staminate flowers inconspicuous: perigynium small, the beak produced to half its length (or more): scales very green and much dilated, often concealing the perigynia, and readily mistaken for bracts.* — **BRACTOIDEÆ**, Bailey.

11. **C. Backii**, Boott. Cespitose: culms 1 to 7 inches high, sharply angled: leaves lax and smooth: staminate portion of the spike about 3-flowered: pistillate flowers 2 to 4, aggregated, more or less spreading: perigynium globose ovate, inconspicuously nerved, smooth or very slightly scabrous above: lower scales longer than the culm. — Dry and rocky hills, Colorado (*Hall and Harbour*), and British America.

§ 4. *Staminate and pistillate spikes distinct: staminate spike single, more or less peduncled: pistillate spikes more or less elongated and peduncled, loosely alternate-flowered (except in C. Richardsoni and No. 13): bracts always sheathed (except in No. 13), the sheaths sometimes membranaceous and leafless: perigynium 3-angled or globular, tightly enclosing the achenium, faintly nerved or nerveless, more or less hairy in the less evolved species, smooth and the short beak curved in the Laxifloræ.* — **DACTYLOSTACHYÆ**, Drejer (in part). Mostly low or undersized species, with a loose habit, growing in dry or grassy places

* *Sheaths membranaceous or hyaline, either not prolonged into a bract or the bract very short and not foliaceous: perigynium more or less 3-angled, hairy in our species and the beak straight.* — **DIGITATÆ**, Fries.

C. RICHARDSONI, R. Br., connecting this section with § 2, is distinguished from *C. Pennsylvanica*, which it strongly resembles, by its peduncled spikes and dark purple leafless sheaths. It occurs in the Eastern States, British America, and California, and may be expected in Montana.

12. **C. concinna**, R. Br. Stoloniferous: culms slender, 2 to 6 inches high, longer than the sharp-pointed leaves: staminate spike small, shortly stalked, its scales obtuse, rarely bearing 1 or 2 pistillate flowers at the top: pistillate spikes 2 to 5, short, rather loosely 2 to 3-flowered, at least the lower ones distinctly peduncled (the peduncles often included in the sheaths), all approximate or aggregated: sheaths very short, each usually bearing an awn-like bract of its own length: perigynium ovate, strigose-hairy, with a short erose beak, longer than the obtuse hyaline-margined scale. — Cottonwood Lake, Wasatch

Mountains, 9,000 feet altitude; and high northward. A delicate and pretty species. The terminal spike is rarely all pistillate.

* * *Sheathless*: bracts green or foliaceous: perigynium triquetrous.—TRIQUETRÆ.

13. **C. pubescens**, Muhl. Whole plant soft hairy: culms slender, 1 to 2 feet high: leaves flat and soft: pistillate spikes 2 to 4, oblong and rather tightly flowered, $\frac{1}{2}$ to $\frac{3}{4}$ inch long, scattered near the top of the culm, the lowest shortly peduncled and subtended by a leafy sheathless bract from 1 to 3 inches long; perigynium ovate, boldly triquetrous, very hairy, contracted into a slender nearly entire beak over half as long as the body: scale broad below, white and thin on the margins, abruptly contracted into a rough awn which equals or exceeds the perigynium. — Missouri River below Fort Pierre (Hayden). A species of doubtful affinity, placed here provisionally.

§ 5. Spike one (in our species), small, the pistillate flowers few: perigynium smooth (sometimes minutely dentate on the angles), firm or horny, mostly shining or glossy, lightly nerved or nerveless, bearing a short beak: scales obtuse with hyaline margins: stigmas 3. (The mature perigynium of No. 15 is unknown) — LAMPROCHILENÆ, Drejer. Small plants, with creeping rootstocks. Our species all fall under the group *Rupestres*, Tuckerm.

14. **C. rupestris**, All. Cespitose and somewhat stoloniferous: culms obtusely angled, erect, 1 to 4 inches high, usually a little longer than the long-pointed and mostly channelled leaves; spike linear or clavate ($\frac{1}{2}$ to 1 inch long): perigynium upright, plano-convex, obovate or elliptic, firm in texture, dull, very lightly nerved, abruptly contracted into a short and stout truncate beak, hidden by the amplexant and very broad dark scale — *C. Drummondiana*, Dew. Sierra Blanca, Col. (Hooker & Gray), and Hall & Harbour No. 273, according to Wm. Boott; British America and high northward. (Eu.)

15. **C. Lyoni**, Boott. Rootstocks somewhat creeping or perhaps strictly cespitose: culms short, 1 to 6 (usually 2 or 3) inches high, rigid, mostly shorter than the very rigid, bristle-like glaucous leaves, surrounded at the base by a mass of brown leafless sheaths: spike linear; the staminate flowers 3 to 6; the pistillate 7 to 9: perigynium ovate-lanceolate, pallid, finely few-nerved; the beak hyaline, minutely and obliquely toothed, about the length or a little shorter than the obtuse and hyaline-margined scale. — Twin Lakes (John Wolfe) and Berthoud Pass (Vasey), Colorado; also in British America. Known only from immature specimens. Its stiff and bristle-like leaves and culms are its best known characters.

16. **C. obtusata**, Lilj. Very extensively creeping by long and slender brownish rootstocks: culms 2 to 7 inches high, longer than the flat and long-pointed leaves: spike at maturity ovate or narrowly ovoid, half-inch or less long, the pistillate flowers 4 to 10: perigynium at first pale, brownish at the top, when mature spreading and becoming brown or dark brown-purple, glossy, very horny in texture, turgid-acute, stipitate, contracted into a stout obliquely cut and conspicuously white-hyaline beak, longer and broader than the membranaceous, acute, and often deciduous scale: achenium short and broadly triangular. — *C. spicata*, Schk. *C. affinis*, R. Br. *C. obesa*, All., var. *monostachya*, Bæckeler. South Park, Colorado, to Montana, westward and northward. (Eu.)

§ 6. *Spikes 2 or more (1 in No. 17), more or less peduncled: staminate spike one in our species: pistillate spikes mostly compactly flowered and cylindrical, erect: bracts leafy, sheathing or sheathless: perigynium firm in texture, smooth (except in No. 24, and in young specimens of No. 23), slightly inflated, very shortly and stoutly beaked or sometimes beakless, conspicuously nerved (except in No. 22). — BRACHYRHYNCHÆ. Slender, not very leafy species.*

* *Spike one, staminate above: perigynium beakless. — POLYTRICHOIDÆ, Tuckerm. Including one very slender species of doubtful affinity, intermediate between the *Pallescens* and the *Elongate*.*

17. **C. polytrichoides**, Muhl. Cespitose: culms many, almost capillary, usually longer than the very narrow leaves: staminate flowers very few: perigynia 2 to 8, alternate and appressed, green, triangular below, flattened towards the top, blunt or emarginate at the apex, much longer than the ovate acute scale: stigmas rarely 2. — Low ground, Colorado and northward.

* * *Staminate spike in our species sessile or short-stalked: pistillate spikes short (occasionally an inch long in No. 19): perigynium obtuse or short beaked, straight at the apex, longer than the white or tawny acute scale. — PALLESCENTES, Fries.*

18. **C. Torreyi**, Tuckerm. Culms 8 to 16 inches high, sharply angled, longer than the hairy leaves: pistillate spikes 1 to 3, roundish, approximate, almost sessile: perigynium round-obovate, sunken at the top, very abruptly tipped with a short stout hyaline-margined beak: bracts short, about the length of the culm, sheathless. — Clear Creek Cañon, near Golden City, Colorado (Rev. E. L. Greene); also in British America; rare.

19. **C. grisea**, Wabl. Culms lax, 8 to 20 inches high: leaves smooth, lax, and flat (3 lines wide in typical forms, often much narrower): pistillate spikes 3 to 6, rather loosely flowered and cylindrical, or sometimes reduced to 2 or 3 flowers, remote, all more or less peduncled: bracts wide and leaf-like, surpassing the culm: perigynium large, turgid-oblong, green, finely manj-nerved, finely punctate with shining glands, beakless or very nearly so: scale rough-awned. — S. Utah (Dr. E. Palmer) and southeastward; Nebraska (Hayden). This species bears little general resemblance to the preceding.

* * * *Staminate spike usually long-peduncled: pistillate spikes scattered, all (at least the lower) on exserted stalks: bracts shorter than the culm (longer in No. 20), sheathing: perigynium glaucous-green before maturity, becoming pale or yellow, the apex oblique or bent and short-beaked (or nearly beakless in No. 20). — PANICEÆ, Tuckerm.*

20. **C. aurea**, Nutt. Stoloniiferous: culm 1 to 12 inches high, slender, sharply angled, longer or shorter than the flat and narrow glaucous leaves: bracts leaf-like, the lower much exceeding the culm: spikes 3 to 6, the staminate often nearly sessile, the pistillate loosely flowered, the lower remote, often on radical peduncles: scales colored on the margins, ovate, shorter than the turgid, globose or pear-shaped, bright yellow or straw-colored and wholly obtuse or slightly pointed perigynium: stigmas commonly 2. — Common throughout on moist grassy hillsides and low mountains. A delicate and pretty species, readily distinguished when mature by its bright colored, often almost fleshy perigynia. The staminate spike is occasionally pistillate at the apex. The apex of the perigynium is often slightly excurved as in the true *Panicæ*.

21. *C. tetanica*, Schk. *Creeping*: culms strict, slender, 6 to 20 inches high, sharply angled, longer than the pale or bluish leaves: staminate spike long-peduncled: pistillate spikes 1 to 4, usually all peduncled, slender, cylindrical, varying from compactly to loosely flowered, attenuated at the base: perigynium tapering at each end, more or less 3-angled, scarcely inflated, with a very short bent point, longer than the nearly obtuse or shortly cuspidate scale. — Indian Territory and northward; also in British America. Distinguished from its eastern allies, *C. panicea* and *C. Meadii* (the latter of which may occur within our limits), by its more slender spikes, which are loosely flowered at the base, and its less inflated perigynium.

* * * * *Terminal spike stalked, pistillate at the top: pistillate spikes oblong or cylindrical, densely flowered, erect: bracts sheathless or nearly so, leaf-like: perigynium ovate or obovate, straight, nearly or quite beakless.* — VIRESCENTES, Kunth.

22. *C. Shortiana*, Dew. Culms leafy, 1 to 2½ feet high: leaves long, flat, rather wide, smooth or very nearly so: pistillate spikes 3 to 6, evenly cylindrical, ¾ to 2 inches long, the lower long peduncled, all sparingly staminate at the base: perigynium broadly and shortly obovate, nerveless, minutely pointed, squarrose, somewhat longer than the rather obtuse scale. — Indian Territory (Geo. D. Butler); Nebraska (Hayden).

23. *C. triceps*, Michx. *Cespitose*: culms slender, 8 to 18 inches high, shorter or longer than the soft, narrow, flat and hairy (rarely nearly smooth eastward) leaves: spikes 1 to 3, approximate and nearly sessile, globular, ovoid, or short cylindrical, thick (½ inch or less long): perigynium sparsely hairy when young, smooth when mature, ovate or broadly obovoid, turgid and conspicuously many-nerved when ripe, pointless and nearly entire or tipped with a very short and slightly 2-toothed beak, about the length of the acute or awn-pointed scale. — *C. hirsuta*, Willd. *C. Smithii*, T. C. Porter. Indian Territory (Geo. D. Butler) and southward.

24. *C. virescens*, Muhl. *Cespitose*: culms many, very slender, 8 inches to 3 feet high, often much attenuated, about the length of the narrow and flat long-pointed, hairy leaves: spikes green, oblong or narrowly cylindrical, ½ to 2 inches long, rarely nearly globose in attenuated specimens, short-stalked and ascending: perigynium ovate or oval, thickly hairy at maturity, strongly few-nerved, beakless, mostly longer than the acute whitish scale. — Indian Territory (Geo. D. Butler).

§ 7. *Staminate spike mostly solitary and peduncled* (sometimes sessile in No. 26), the upper part usually pistillate in the *Gracillimæ*: pistillate spikes several or many, more or less loosely flowered, all or the lower on filiform weak or nodding peduncles: bracts foliaceous and sheathing: perigynium thin and membranaceous, usually slender or oblong, tapering gradually into a distinct or long minutely toothed straight beak, smooth and shining (in No. 23 usually hairy on the angles and not lucid), mostly light-colored, somewhat inflated. Scales thin, white, tawny, or brown. — HYMENOCHLÆNÆ, Drejer. Mostly slender and open-flowered lax-growing species.

* *Terminal spike usually pistillate above: pistillate spikes narrow, long-cylindrical, rather compactly flowered, the lower on long-exserted or nodding peduncles*

perigynium ovate-oblong, many-nerved, turgid, green at maturity.—**GRACIL-LIMÆ**, Carey.

25. **C. Davisii**, Schw. and Torr. Culm leafy, lax, 1 to 2 feet high: leaves wide and flat, pale, more or less hairy: pistillate spikes about three, usually an inch or more long and two or three lines broad: perigynium large and turgid, prominently 12 to 15-nerved, gradually narrowed into a short and stout slightly 2-toothed beak, about the length of the pale awned scale.—*C. Torreyana*, Dew. Moist grassy places, Indian Territory (*Geo. D. Luther*) and northward.

* * *Terminal spike all staminate: pistillate spikes in our species very narrow and slender and long-exserted and nodding, loosely flowered: perigynium small, not inflated.*—**DEBILES**, Carey.

26. **C. arctata**, Boott. Slender, 1 to 2 feet high: culm leaves short (2 to 4 inches) and broad; radical leaves mostly short and spreading, all smooth: pistillate spikes long-linear, 1 to 3 inches long and a line wide, all nodding at maturity, very loosely flowered towards the base: perigynium small, somewhat 3-angled, prominently about 2 or 3-nerved, pointed, rather longer than the acute, white scale.—Along the Missouri at Fort Pierre (*Dewey*).

* * * *Terminal spike all staminate: pistillate spikes oblong, club-shaped or cylindrical (very small in No. 27), less drooping: perigynium few-nerved or nerveless, tawny or whitish.*—**FLEXILES**, Tuckerm.

27. **C. capillaris**, L. Usually densely caespitose: culms very slender, varying from an inch to 15 inches (var. *elongata*, Olney) in height, much longer than the numerous very narrow radical leaves: pistillate spikes 1 to 4, loosely 3 to 10-flowered, long-exserted and nodding, the lower often very remote: perigynium small, ovate or ovate-oblong, contracted into a nearly entire beak of about half its length, about the length or longer than the white or tawny hyaline scale.—High mountains from Colorado westward and northward. A delicate species, variable in size and in the length and shape of the pistillate scales. (Eu.)

28. **C. frigida**, All. Stoloniferous: culm slender, 1 to 1½ feet high, much longer than the short and rather broad many-nerved, lux radical leaves: bracts conspicuously and loosely sheathing, the lower more or less leaf-like, the upper setaceous: pistillate spikes ferruginous, nearly or quite an inch long, the lower club-shaped and long-exserted, the upper more or less cylindrical and often sessile or nearly so and approximate: perigynium lanceolate, slightly inflated, flattened, at first wholly or partly green, at length becoming more or less ferruginous, obscurely nerved, hairy on the angles, tapering and 2-toothed, longer than the acute dark-brown scale.—Cottonwood Lake, Utah (*Sereno Watson*); also in Oregon. (Eu.)—(See Addendum.)

29. **C. longirostris**, Torr., var. **minor**, Boott. Caespitose: culm rather strong, 6 to 8 inches high, obtusely angled, rather longer than the flat and soft leaves: pistillate spikes 2 to 3, greenish-white, short (½ inch long), thick, nearly erect: perigynium large, 2-nerved, green and shining, produced into a slender white-tipped toothed beak of half or more its length: scale white, acute or cuspidate, about the length of the perigynium.—Colorado (*Hall & Harbour*).—The species, differing in its much greater size, longer and at length long-pendulous spikes, and very long-beaked perigynium, occurs near the boundary in British America.

§ 8. *Staminate spikes one or more: pistillate spikes two to several, stout, erect, mostly shortly peduncled, somewhat squarrose or comose in appearance: perigynium thick in texture, hairy, more or less spreading, distinctly and stoutly straight-beaked, the teeth short: scales prominent.*—LASIOCARPÆ, Fries. Stout, mostly tall species, in wet or grassy places. Our species falls under the group *Lanuginosæ*, Carey.

30. *C. filiformis*, L., var. *latifolia*, Beklr. Stoloniiferous: culms 1 to 2½ feet high, strong: leaves flat 1 to 2 lines broad, about the length or longer than the culm: staminate spikes 1 to 3, the lower small and aggregated at the base of the terminal one: pistillate spikes 1 to 4, remote, sessile or nearly so, or the lower peduncled, ¾ to 2 inches long, often loosely flowered at the base: bracts leaf-like, usually much exceeding the culm, the upper sheathless: perigynium ovate or shortly ovoid, abruptly contracted into a very short, erect, divergently and very shortly toothed beak: scales ovate, purple, acute or cuspidate, shorter or longer than the turgid and densely hairy perigynium.—*C. lanuginosa*, Michx. *C. pellita*, Muhl. Throughout, in wet and swampy places.

Var. *æmatorhyncha*, W. Boott, is a form with purple beaks: scarcely distinct from the last variety.—*C. æmatorhyncha*, Desv. Jordan Valley, Utah (*Sereno Watson*).

The species may be expected in Montana. It is distinguished by its filiform and involute leaves.

§ 9. *Staminate spike mostly single: pistillate spikes 2 to 4, short, oblong or globular, sessile or nearly so, erect, compactly flowered, in our species approximate at the top of the culm and subtended by long and leafy bracts: perigynium smooth, nerved, conspicuously beaked, not prominently toothed.*—SPIROSTACHYÆ, Drejer. Rather slender species.

31. *C. flava*, L. Culm slender, 4 to 18 inches high, smooth, longer than the narrow stem leaves: bracts much longer than the culm, leaf-like, very shortly sheathed: staminate spike short, mostly sessile: perigynium shining, yellowish, reflexed at maturity, twice the length of the scale.—Meadows and wet places, Hudson Bay Creek, Montana (*W. M. Cunby*), and northward. (Eu.)

§ 10. *Staminate spikes two or more, long-stalked: pistillate spikes 2 to several, usually all peduncled, long and heavy, loosely flowered, erect or nodding: perigynium large, thick in texture, strongly nerved, hairy or smooth, produced into a long beak which terminates in very conspicuous awl-like erect or spreading teeth.*—ECHINOSTACHYÆ, Drejer. Coarse species.

32. *C. trichocarpa*, Muhl. var. *aristata*, Bailey. Culms very stout, sharply angled: sheaths and under side of the leaves sparsely hairy: staminate spikes 3 to 8, usually considerably separated; the scales very long, loose and pointed: pistillate spikes 2 to 3 inches long, 5 lines or more broad, upright, scattered, loosely flowered at the base: perigynium very strongly nerved, smooth, ovate-lanceolate, terminated by very conspicuous divaricate, smooth and slender teeth (which are 1½ to 2 lines long), usually longer than the rough-awned scale.—*C. aristata*, R. Br. *C. mirata*, Dew. Bogs and creeks, Utah (*Watson, L. F. Ward*); to British America.

Var. **Deweyi**, Bailey. Usually more slender than the last, the leaves and sheaths smooth: pistillate spikes 1 to 2 inches long and $\frac{1}{2}$ inch or less broad: perigynium very smooth, usually somewhat polished, rather coriaceous, the nerves not conspicuous, the teeth mostly short: scale usually not conspicuously awned. — *C. laviconica*, Dew. Big Sioux and Yellowstone Rivers (*Hayden*). Bismarck, North Dakota (*A. B. Seymour*). These varieties pass by all gradations into the species, which may occur within our eastern limits.

§ 11. *Sterile and fertile spikes one to several or many: fertile spikes mostly large and compactly flowered: perigynium much inflated (cross-section nearly twice or much more than twice the width of the mature achenium), membranaceous, smooth, conspicuously nerved (or nearly nerveless in No. 35), tapering into a toothed beak as long as the body or longer.* — **PHYSOCARPÆ**, Drejer. Mostly large and stout species, to be regarded as the most developed of the genus. No. 35 is the least developed of the section, and in some forms it appears to ally itself with other and very dissimilar sections.

* *Staminate spike solitary, stalked: pistillate spikes sessile or nearly so, short and thick, at maturity green or greenish-tawny, usually turning dark-colored in drying: perigynium large, very turgid at the base, gradually lengthened into a long-conical slenderly toothed beak which much exceeds the scale.* — **LUPULINÆ**, Tuckerm.

33. **C. lupulina**, Muhl. Tall and leafy (2 to 3 feet high): fertile spikes 2 to 4, several to many-flowered, heavy, turgid-oblong or cylindrical, approximate or the lower remote and on more or less exserted stalks, becoming nearly straw-colored at full maturity: bracts wide, long and leaf-like, the lower sheathing: perigynium upright. — Indian Territory and southward in wet places.

C. INTUMESCENS, Rudge, distinguished by its few-flowered and aggregated sessile, greener spikes, sheathless bracts, and more spreading perigynia, has a similar range as the last, but has not yet been found within our limits. It also occurs in British America.

* * *Staminate spikes commonly more than one: pistillate spikes usually long and densely cylindrical (short in No. 35 and occasionally in No. 38): perigynium smooth and shining, long-beaked, at maturity yellow or straw-colored, or occasionally partly reddish purple.* — **VESICARIÆ**, Tuckerm.

← *Staminate spike one: pistillate spikes comose, cylindrical and drooping or spreading: bracts sheathless or nearly so: beaks long.*

34. **C. hystericina**, Muhl. Plant rather slender, pale, 12 to 18 inches high: spikes 2 to 4, narrow ($\frac{1}{4}$ to 2 inches long and $\frac{1}{2}$ inch and less wide), nodding or the upper one nearly erect or spreading, decidedly comose in appearance: perigynium 15-nerved, not prominently inflated, prolonged into a very slender and setaceous toothed beak, the lobes of which are spreading: scales awn-like, shorter than the perigynium — *C. Cooleyi* and *C. Thurberi*, Dew. Wet places, New Mexico and northeastward to Nebraska. Distinguished from *C. tentaculata*, Muhl., which may occur within our southeastern border, by its smaller, more comose and more nodding spikes, and by its smaller

or more nerved (10-nerved in that species) perigynia. *C. hystrixina* affords a transition to the *Echinostachyæ*.

C. squarrosa, L., occurs at Fayetteville, N. W. Arkansas (*F. L. Harvey*). It is at once distinguished by its exceedingly densely flowered short, upright spikes, the terminal one being androgynous. It is one of the *Squarrosæ*, Carey.

+ + *Staminate spike one, rarely two: pistillate spikes short, erect, more or less purplish: beaks short: stigmas usually two.*

35. *C. saxatilis*, L. Stoloniferous: culm 4 to 12 inches high, sharply angled, about the length of, or a little longer than, the narrow and sharp-pointed leaves: pistillate spikes one to three, the upper sessile or nearly so, the lower mostly more or less peduncled, all dark purple or at maturity becoming brown: bracts narrow, long-pointed, shorter or a very little longer than the culm: perigynium ovate-oblong or elliptic, nerveless or very inconspicuously nerved at the apex, rather abruptly contracted into a very short nearly entire beak, mostly longer than the more or less obtuse membranaceous scale. — *C. pulla*, Gooden. *C. vesicaria*, var. *alpigena*, Fries. Rocky mountains of British America and northward, and no doubt on our higher mountains. (Eu.)

Var. *Grahami*, Hook. & Arn. Stouter, 12 to 20 inches high: perigynium lighter colored, often nearly straw-colored, prominently few-nerved, the beak longer and more conspicuously toothed. — *C. Grahami*, Boott. *C. vesicaria*, var. *dichroa*, Anderss. *C. saxatilis*, var. *major*, Olney. High mountains of Colorado, Utah, and northward. (Eu.)

+ + + *Staminate spikes two or more: pistillate spikes normally long, spreading or drooping: stigmas three.*

+ + *Perigynium conspicuously turgid, ascending at maturity.*

36. *C. vesicaria*, L. Stoloniferous: culms stout, 1 to 2½ feet high, scabrous, shorter than the upper leaves: leaves flat, 2 to 3 lines broad: pistillate spikes 2 to 4, thick (4 to 8 lines in diameter), the upper sessile, the lower on weak or nodding peduncles: perigynium ovate-lanceolate, one third or less as broad as long, gradually tapering into a slender beak, 12 or more nerved, longer than the inconspicuous scale. — Uinta Mountains, Utah? (No. 1270 King's Survey, an immature specimen), California, and Oregon. (Eu.)

37. *C. monile*, Tuckerm. Culms usually more slender and leaves a little narrower: spikes more slender: perigynium subglobose, much inflated towards the base, one half or more as broad as long, abruptly short-beaked, 10 or less nerved: otherwise as in the last. — *C. Vaseyi*, Dew. Colorado (*Vasey*).

+ + + *Perigynium not conspicuously turgid, squarrose at maturity, and the spikes comose in appearance.*

38. *C. utriculata*, Boott. Somewhat stoloniferous: culm very stout (1 to 3 feet high), acutely angled above, very thick and spongy at the base: leaves broad (2 to 6 lines), carinate at the base, much exceeding the culm, conspicuously nodulose-reticulated: pistillate spikes 2 to 6, more or less remote, the upper sessile, the lower often on weak peduncles an inch or two long, long-cylindrical or terete (1 to 7 inches long), thick and compactly flowered (sometimes

loosely flowered at the base), often staminate at the top: perigynium ellipsoid or globose-ovoid, usually gradually tapering into a short beak, broader and commonly longer than the very acute or rough-awned scale. — Var. **MINOR**, Sartwell, is a form smaller in all its parts, with spikes an inch or so long. — Common in swamps from Colorado and Utah northward. Too near the next.

39. **C. ampullacea**, Good. Culm rather slender, obtusely angled, not conspicuously thickened at the base: leaves narrow ($\frac{3}{4}$ to 2 lines broad), canaliculate, finely and inconspicuously nodulose below, gradually tapering into very long points: spikes fewer, narrower and shorter, more approximate, the lower seldom much exerted: perigynium subglobose or globose-elliptic, in typical forms shortly and abruptly beaked, longer than the normally muticous scale. — In similar situations with the last, but evidently less common, from Colorado and Utah northward. (Eu.)

§ 12. Staminate spikes one or more, long: pistillate spikes one to several, brown, purple, or greenish, commonly approximate, sessile or peduncled, oblong or linear, mostly elongated: perigynium not inflated, biconvex, minutely beaked or beakless, smooth: stigmas 2. — **MICRORHYNCHÆ**, Drejer. Paludose and alpine species of upright habit, often growing in tufts or tussocks. Our species fall under the group *Acutæ*, Fries.

* *Perigynium strongly nerved.*

40. **C. Jamesii**, Torr. Stoloniferous: culm 1 to 2 feet high, rough on the sharp angles, longer than the glaucous, long-pointed leaves: staminate spikes 1 to 4, usually one, large, occasionally bearing a few pistillate flowers at the top: pistillate spikes 2 to 4, erect, the upper sessile or nearly so, the lower more or less peduncled, broadly cylindrical, often inclining to club-shaped; lower bract often leaf-like: perigynium oval or obovate, ascending, abruptly contracted into a short, toothed (rarely nearly entire) beak, greenish, about the length of, or a little longer than, the obtuse or abruptly cuspidate scale, and twice as broad. — Colorado, Utah, and southward. Spikes sometimes purplish.

Var. **Nebraskensis**, Bailey. Culm stouter, smooth or nearly so, about the length of the leaves: pistillate spikes mostly short, narrowly cylindrical or terete: perigynium squarrose or spreading, usually rusty brown, a little shorter than the gradually pointed, narrower scale. — *C. Nebraskensis*, Dew. With the species and eastward.

* * *Perigynium slightly nerved or nerveless.*

+ *Robust species (mostly): bracts leaflike, usually exceeding the culm.*

41. **C. laciniata**, Boott. Culm very sharply angled, 2 to 3 feet high, rough on the angles, at least above: leaves very long: pistillate spikes 3 to 6, dark brown, 1 to 3 inches long, cylindrical and closely flowered, remote, the upper sessile, the lower nodding or spreading on exerted peduncles and loosely flowered at the base: perigynium oval or elliptic, sometimes nearly circular, contracted into a short, toothed beak, usually toothed on the angles above (the teeth deciduous with age), faintly several nerved, about the length of the narrow pale-

ribbed, ciliate (laciniate) scale. — Provost River, N. Utah (*Sereno Watson*; an ambiguous specimen). The leaves usually dry, stiff and hard. The lowest bract is often very much prolonged.

42. *C. aquatilis*, Wahl. *Stoloniferous: culm obtusely angled, 2 to 3 feet high, smooth, leafy: leaves flat, pale, scarcely longer than the culm: pistillate spikes 2 to 4, erect, thick and compactly flowered throughout or more commonly inclining to club-shaped with a gradually attenuated base, the upper sessile, the lower more or less peduncled and often long-exserted: perigynium broadly elliptic or obovate, rarely circular, nerveless, tipped with a minute and entire point, green or light-colored, wider and either longer or shorter than the green or purple-margined acutish scale.* — Wyoming (*W. Boott*); probably generally distributed. A large species in wet places, readily distinguished from the next by its stout and leafy smooth culms, wide and amplexant bracts, and thick spikes. (Eu.)

Var. *sphagnophila*, Anders. *Slender, 8 to 16 inches high: leaves very narrow, long-pointed: spikes slender, very loosely flowered and long-attenuated below, the lower peduncles slender and flexuose: perigynium about the width of or a little wider than the dark purple scale.* — *C. aquatilis*, var. *minor*, Boott. *C. borealis*, Lange. *C. personata*, Olney. Twin Lakes, Colorado (*John Wolfe*); also in British America. (Eu.)

C. LENTICULARIS, Michx., may be expected northward. It may be distinguished from *C. aquatilis* by its smaller size, narrower spikes the terminal one of which is pistillate at the top, and the nerved perigynium.

+ — *Low or tall and slender species: bracts mostly short and narrow, often setaceous (rarely long in Nos. 42 and 43).*

++ *Culms slender and tall (2 feet or more high): leaves with more or less revolute margins when dry.*

43. *C. stricta*, Lam. *Densely cespitose, forming high tussocks in wet places: culms 2 to 5 feet high, sharply angled, rough, leafy only at the base, longer than the narrow and long-pointed carinate leaves, when full grown surrounded below by the conspicuous reticulated fibrous remains of the older sheaths: pistillate spikes 2 to 4, erect or spreading, sessile or the lower shortly peduncled and sometimes loosely flowered at the base, linear, often male at the top; lower spike or two often subtended by a narrow bract barely as long as the culm: perigynium oval or ovate, green or light-colored, nerveless or nearly so, the point entire or slightly emarginate, little broader and longer or shorter than the purple-margined ascending acute or acutish scale.* — *C. Virginiana*, Smith. *C. acuta*, Muhl., etc. *C. angustata*, Boott. *C. xerocarpa*, S. H. Wright. Colorado (*Brandegee, Vasey*).

44. *C. aperta*, Boott, var. *divaricata*, Bailey. Differs from the last in its smoother culm, in the absence of reticulated fibrous sheaths, and in the broader perigynium which is subtended by an acute spreading scale of more than its own length: bracts sometimes leaf-like. — Colorado (*Vasey*). Differs from the typical Eastern *C. aperta*, which may be expected in our region, in its greater size, wider leaves, and looser habit, larger perigynia, and more conspicuously divaricate, darker scales.

++ ++ Culms 3 to 18 inches high: leaves more or less involute when dry.

45. *C. vulgaris*, Fries. Stoloniferous, not tufted, bluish in appearance: culms mostly stout, sharply angled, smooth except near the top, longer than the narrow leaves: staminate spikes 1 to 3, usually 2: pistillate spikes 2 to 4, usually about an inch long, stout, densely flowered (or the lower rarely loosely flowered at the base), erect, sessile or the lower shortly peduncled, green and black in appearance, with a bract nearly or quite as long as the culm: bracts usually bearing minute purple auricles at the top of the sheath: perigynium appressed, oval, ovate or round-ovate, finely striate towards the base, bright green above the middle, the distinct beak entire or emarginate, longer and broader than the obtuse, black, green-nerved appressed scale. — Twin Lakes, Colorado (*John Wolfe*: these specimens were named *C. turfosa*, Fries, in the Preliminary Report of Wheeler's Survey, but they lack the yellowish-purple spikes and rough-angled perigynia of that Scandinavian plant).

A perplexingly variable species, distinguished from Nos 43 and 44 by its lower, stiffer, less cespitose habit, and thicker, oblong, conspicuously green and black spikes, and more nerved perigynia, rather than by any positive descriptive characters. Scandinavian caricographers state that reticulated basal sheaths never occur in any of the forms of this species. The auricles at the base of the bracts are often inconspicuous, and they are sometimes present in *C. stricta* and others of the *Acute*. The type of the species is common in the Eastern United States, in Europe, and in Asia. In our region the following varieties appear to be clearly made out: —

Var. *juncella*, Fries. Cespitose and very slender: leaves narrow, longer than the culm: spikes linear, often much attenuated at the base: perigynium elliptic or broader, distinctly nerved and beaked, longer than the obtuse black-margined scale. — *C. Kelloggii*, W. Boott. Wahsatch Mountains, Utah (*Watson, M. E. Jones*). Different from all other forms of *C. vulgaris* in its slender and lax habit. It much resembles the type in the green and black of its spikes. (Eu.)

Var. *hyperborea*, Boott. Culms and leaves as in the species: staminate spike one: pistillate spikes 3 to 5, slender, lax, loosely flowered at the base, the lower peduncled and often remote, black-purple or fuscous-purple: perigynium narrow, mostly elliptic, almost pointless, entire at the orifice, very faintly nerved towards the base, shorter or rarely a little longer than the acute or acutish dark purple scale. — *C. hyperborea*, Drejer. *C. limula*, Fries. *C. Bigelovii*, Torr. *C. Washingtoniana*, Dew. *C. rigida*, var. *Bigelovii*, Tuckerm. Alpine regions, Colorado, northward and westward. (Eu.)

Var. *alpina*, Boott. Leaves broad (2 lines) and flat: staminate spikes sometimes 2, usually 1: pistillate spikes 3 to 5, short and thick (3 to 9 lines long), erect, approximate or the lowest sometimes remote and shortly peduncled, dark purple: auricles very prominent: perigynium obovate or nearly circular, nerveless, shortly beaked, pale below, usually more or less purple above, commonly shorter than the very dark, acute scale. — *C. rigida*, Gooden. *C. saxatilis* of Scand. authors, not L. With the last. (Eu.)

§ 13. Staminate spike one, short, either pistillate above or not conspicuous (except in No. 46): pistillate spikes none to several, short and thick, mostly dark-colored, commonly aggregated (often only approximate) sometimes staminate at

the base: perigynium biconvex or very obtusely 3-angled, with a very short entire or emarginate beak, or beakless: stigmas 2 or 3. — **MELANOSTACHYÆ**, Tuckerm. Mostly mountain or boreal species, distinguished by the aggregated spikes and inconspicuous or androgynous terminal spike and nigrescent color. To be regarded as probably the least evolved section of the genus, connecting the two subgenera.

* *Terminal spike all staminate (in No. 46 often with a few pistillate flowers at base or apex, or rarely all pistillate and diœcious), cylindrical: pistillate spikes approximate, erect: stigmas usually 3.* — **STYLOSÆ**.

46. **C. Parryana**, Dew. Stoloniferous: culms rigid, 2 to 16 inches high, stout, obtusely angled, smooth or nearly so, granulated, longer than the rigid, long-pointed, narrow leaves: terminal spike usually largest, about an inch long, brown, with 1 to 5 small, globular, oblong, or cylindrical erect spikes near its base (or sometimes entirely solitary!), the lower usually subtended by a narrow bract shorter than the culm and often more or less remote and shortly peduncled: perigynium obovate or triangular-obovoid, somewhat plano-convex, scabrous above, lightly nerved especially on the outer side, very abruptly short-beaked, the orifice entire or erose-hyaline, shorter and about the width of the very obtuse, brown, white-nerved, hyaline-margined, sometimes minutely apiculate and ciliate scale. — *C. arctica*, Dew. *C. Hallii*, Olney. South Park, Colorado, and northward in the mountains: rare. Named for Capt. Parry, the Arctic explorer. The monostachyous specimens resemble No. 5, from which they are readily distinguished by the hairless perigynia.

47. **C. Raynoldsii**, Dew. Stoloniferous: culms 13 inches to 3½ feet high, sharply angled, longer than the flat, glaucous leaves: staminate spike sessile, about half an inch long: pistillate spikes 3 to 6, short and thick (4 lines wide), not commonly more than twice as long as broad (and usually less), sessile or short peduncled, aggregated, or the lowest an inch or two remote and exerted: lower bract about the length of the culm, bearing conspicuous purple awicles: perigynium large, obovoid, 3-angled, prominently nerved, green or light-colored, abruptly narrowed into a nearly entire purple beak, somewhat spreading, when mature much longer and broader than the acute black scale. — *C. Lyallii*, Boott. Mountains, Utah to Wyoming.

* * *Terminal spike staminate: pistillate spikes ovoid or oblong and drooping: stigmas 3.* — **LIMOSÆ**, Tuckerm.

48. **C. Magellanica**, Lam. Loosely tufted: culms 1 to 2 feet high, smooth, about the length of or shorter than the leaves: pistillate spikes 2 to 4, rather loosely flowered, on peduncles of about their own length, sometimes with a few staminate flowers at their base or apex, the lowest with a bract which exceeds the culm: perigynium nearly orbicular, granular, whitish, entire at the orifice, few-nerved, about half as long as the long-pointed brown-purple scale. — *C. irrigua*, Smith. Uinta Mountains, Utah. (Eu.)

* * * *Terminal spike club-shaped, staminate below: lateral spikes occasionally bearing a few staminate flowers at base.* — **ATRATÆ**, Kunth.

← *Scales, especially of the terminal spike, narrow and acuminate, very acute or awned, much longer than the perigynia.*

49. **C. Buxbaumii**, Wahl. Stoloniferous: culm 1 to 2 feet high, sharply angled, rough above, about the length of the firm, narrow leaves: pistillate

spikes 2 to 5, erect, sessile, or the lowest very shortly peduncled, distinct, usually more or less remote, glaucous-purple: perigynium elliptic, glaucous, nerved, rough-granular, contracted into a short emarginate or entire beak. — Bogs throughout, but evidently nowhere common. The terminal spike is rarely all staminate. The lower leaf sheaths are purple and at length fibrillose. (Eu.)

+ + *Scales broad, not conspicuously acute.*

50. **C. atrata**, L. *Cespitose*: culm 6 inches to 2 feet high, sharply angled, smooth or roughish, longer than the long-pointed leaves: bracts about equaling the culm, mostly with conspicuous auricles: spikes 2 to 4, densely flowered, clavate or oblong, thick, $\frac{1}{2}$ to $1\frac{1}{2}$ inches long, black or dark brown, approximate or often aggregated, all more or less peduncled, at first upright or spreading, at length usually drooping and often exserted, and the top of the culm appearing as if bent over: perigynium broadly ovate or orbicular, nerveless, bearing a short notched beak, commonly a little broader and about the length or a little shorter than the black or dark brown obtuse or acutish scale. — Varies much: the spikes are sometimes more or less erect at maturity, the upper spike is rarely all staminate, and the upper scales are often acuminate but never awned. High mountains, Colorado and Utah and northward. (Eu.)

Var. **nigra**, Boott. *Spikes short, about as broad as long, densely aggregated and capitate, sessile, erect: midnerve of the scale generally projecting into a short cusp: perigynium usually scabrous.* — *C. nigra*, All. With the last. (Eu.)

Var. **ovata**, Boott. Resembling the drooping or open forms of the species, but the spikes more slender, the whitish or green perigynium conspicuously broader and mostly longer than the brown scale, giving to the graceful spikes a conspicuous light and dark appearance. — *C. ovata*, Rudge. Colorado, Utah, and southward.

Var. **erecta**, W. Boott. Like the last, but the spikes erect, short, sessile or nearly so, and the staminate scales narrow. — Nevada and westward; probably in our region.

51. **C. alpina**, Swartz. *Culms very slender, 6 inches to 2 feet high, smooth, longer than the narrow leaves: spikes 2 to 4, small ($\frac{1}{2}$ inch and less long), mostly compactly flowered, black or black and green, closely aggregated, erect and capitate, the lowest very short-stalked and usually subtended by a green bract: perigynium ovate or elliptic, obscurely nerved or nerveless, with a short slightly notched beak, green or fuscous, commonly a little longer than the ovate, black, nearly obtuse scale* — *C. Fahlii*, Schk. High mountains, South Park, Colorado, and northward. A delicate species, distinguished from erect forms of the preceding species by its slender naked culm, and small, nearly globular spikes.

SUBGENUS II. Vigneæ. Staminate flowers few and inconspicuous, borne at the base or apex of the pistillate spikes. Pistillate flowers in short, sessile spikes (spike single in Nos. 52 and 53), which are commonly more or less aggregated into heads, or even panicle. Cross-section of the perigynium plano-convex in outline. Styles two and achenium lenticular. — The spikes, and especially the terminal one, usually have contracted bases when the staminate flowers are borne below, and empty scales at the top when the staminate flowers are borne above.

§ 14. *Staminate flowers borne at the top of the pistillate spikes; or in the Arenariæ spikes often wholly staminate and the plants occasionally diœcious.* — ACROARRHENÆ, Anderss.

* *Spike one and simple: plants very small.* — NARDINÆ, Tuckerm.

52. **C. nardina**, Fries. *Densely cespitose: culms $\frac{1}{2}$ to 5 inches high, rigid, about the length of the very numerous, setaceous, rigid or stiffly recurved leaves: spike 1 to 4 lines long, compactly flowered: perigynium oval or elliptic, obscurely nerved, abruptly very short beaked, erect, when mature usually about the length of the broad and obtuse brown scale.* — Upper Marais Pass (W. M. Canby), and high northward. Resembles the tristigmatous No. 14, with which it should perhaps be associated. (Eu.)

53. **C. gynocrates**, Wormsk. *Creeping: culms 3 to 8 inches high, longer than the rigid, erect or spreading leaves: spike 2 to 6 lines long, loosely flowered (perigynium sometimes but one, C. monosperma, Macoun): perigynium ovate, prominently nerved, gradually and conspicuously beaked, spreading at maturity, longer than the acute scale.* — South Park, Colorado (John Wolfe), and in British America. (Eu.)

* * *Spikes green when mature, aggregated or remote, never in compound heads.* (Here may be sought forms of No. 59.) — MUHLENBERGIANÆ, Tuckerm.

+ *Spikes few-flowered, distinct, often remote.*

54. **C. tenella**, Schk. *Tufted and stoloniferous: culms very slender, almost capillary, 6 to 16 inches high, about the length of the narrow, loose leaves: spikes scattered, 1 to 6-flowered: perigynium shortly oval, rounded on the outside, finely nerved, abruptly and minutely beaked, longer than the very thin scale.* — *C. disperma*, Dew. *C. gracilis*, Carey. Swamps throughout.

55. **C. rosea**, Schk., var. **retroflexa**, Torr. *Tufted: culms slender, smooth, longer than the narrow leaves: spikes 3 to 8-flowered, mostly approximate, the lower distinct but not remote, stellate in appearance when mature: perigynium sessile, ovate-lanceolate, smooth throughout, finely nerved and spongy-thickened at the base on the inner side, gradually tapering into a toothed beak, at maturity widely spreading or reflexed, a little longer than the very acute scale.* — *C. retroflexa*, Muhl. Dry banks and copses, Indian Territory and southward. The species which probably occurs within our limits is distinguished by its more scattered spikes, shorter scales, and scabrous upper angles of the perigynium. From its allies, the species and its variety are distinguished by their small and stellate spikes.

+ + *Spikes several to many-flowered, aggregated into a globular or oblong head.*

56. **C. cephalophora**, Muhl. *Cespitose: culms rather stout, rough, rather longer than the narrow leaves: spikes 3 to 6, small, very densely aggregated, the head subtended by a setaceous, rarely leafy bract: perigynium broadly ovate, rather abruptly short-beaked, obscurely nerved on the outer side, rough above, mostly longer than the acute or cuspidate scale.* — Indian Territory and southwestward.

57. **C. Muhlenbergii**, Schk. *Culm stiff, 1 to 2 feet high, very sharply angled, rough, usually a little longer than the narrow and long-pointed leaves:*

spikes 6 to 10, aggregated into an oblong more or less interrupted heavy head, each one subtended by a short setaceous bract: perigynium large, broadly ovate or orbicular-ovate, very conspicuously nerved, about the length of the rough-awned scale. — Sterile soil "on the Missouri below Fort Pierre" (Prof. Dewey).

58. *C. cephaloidea*, Boott. Distinguished from the last by its broad and long flat leaves (about $\frac{1}{4}$ inch wide), wing-margined entirely nerveless perigynium, and somewhat tawny heads. — Fort Pierre, South Dakota, and southward.

* * * Spikes tawny or brown, somewhat chaffy in appearance, closely aggregated or densely capitate: perigynium ovate or ovate-lanceolate, not conspicuously nerved. — FÆTIDÆ, Tuckerm.

+ Perigynium conspicuously rough on the angles above.

59. *C. muricata*, L. One to two feet high, erect, the culm scabrous: spikes 3 to 12-flowered, approximate into a loosely interrupted head, the lower distinct, the pointed perigynia and scales conspicuous: perigynium green or greenish, stalked, ovate or ovate-lanceolate, nerveless or nearly so, gradually beaked, spreading, about the length of the acute brown scale. — Banks, Colorado, Utah, and southward. (Eu.)

Var. *confixa*, Bailey. Culms very slender, usually prolonged (1 to $2\frac{1}{2}$ feet high): spikes 5 to 10-flowered, brown and green or tawny, aggregated into a rather loose continuous oval or oblong naked head (which is $\frac{1}{2}$ to 1 inch long): perigynium usually narrower than in the species. — *C. Hoodii* of authors, not Boott. Wasatch Mountains, Utah (Watson, 1228): N. W. Wyoming (Parry 281); also in British America, Oregon, and California. Distinguished from No. 58 by its smaller size, weak culm, narrow leaves, narrow perigynium, and rounder, smaller head. Much like *C. Hoodii*, Boott, which is distinguished by its stiffer culm, much heavier, more compact, and browner heads, which are made up of more numerous-flowered, more chaffy, and much longer more or less pointed spikes, and more upright perigynia which are mostly concealed beneath the scales. That species occurs in California and Oregon.

Var. *gracilis*, Boott. Slender: head more interrupted than in the species, almost linear, more fuscous, each spike subtended by a pointed or awned bract: perigynium erect, shorter than the very acute or cuspidate scale. — *C. Hookeriana*, Dew. With the species, and northward and eastward.

+ + Perigynium smooth or slightly scabrous.

60. *C. foetida*, All. Creeping: culm 5 to 16 inches high, rather stout, scabrous, longer than the long-pointed leaves: spikes very densely aggregated into a globose or ovoid brown head: perigynium lanceolate or ovate-lanceolate, toothed at the apex, about the length of the acute or mucronate brown scale. — Mountains, Colorado, Utah, and Wyoming. (Eu.)

61. *C. incurva*, Lightf. ? Extensively creeping: culm stiff and short ($\frac{1}{2}$ to 6 inches long), smooth, usually curved, about the length of the narrow and stiff curved leaves: spikes 2 to 5, crowded into a short-ovoid or globular brown or tawny head (which is only $\frac{1}{4}$ to $\frac{3}{4}$ inch long): perigynium large and turgid, stipitate, broadly ovate, conical above, purple towards the top, faintly many nerved on one side at least, narrowed into a short and stout entire beak, not covered by the acute, thin scale. — Rocky Mountains of British America. Immature speci-

mens from an alpine ridge near Middle Park (C. C. Parry) and from near Mt. Gray (H. N. Patterson), Colorado, are probably to be referred here. The specimens are peculiar for their upright habit, large and dark heads, and very broad, inflated perigynia.

62. **C. stenophylla**, Wahl. *Stoloniferous: culms stiff, 1 to 6 inches high from a mass of fibrillose sheaths, usually longer than the stiff involute filiform leaves: spikes 3 to 6, short (2 to 4 lines long), nearly globose, loosely conglomerated into a small subglobose or shortly oblong head, each spike subtended by a scarious mucronate bract of less than its own length: perigynium ovate, brown, nerved, gradually contracted into a short, blunt, entire beak, tightly enclosing the achenium, at maturity longer than the hyaline, brown, acutish scale.* — Dry hills and mountains, New Mexico, Colorado, eastward and northward; also in Iowa. (Eu.)

C. TERETIUSCULA, Gooden., distinguished by small chestnut-colored spikes disposed in an appressed or loose nearly simple panicle, will probably be found in Montana.

* * * * Spikes yellow or tawny when mature (in No. 63 often green), aggregated into more or less compound heads or panicles: perigynium many-nerved, stipitate, tapering from a spongy base into a more or less conspicuous beak. — VULPINÆ, Kunth.

+ Beak shorter than the body of the perigynium.

63. **C. conjuncta**, Boott. Culms flat, about the length of the broad and lax leaves: spikes 6 to many, loosely disposed into a long and interrupted head, the lower branches of which are sometimes compound: perigynium ovate, rough on the angles above, the base cordate on the outer side and conspicuously white-thickened, broader and a little longer than the acute scale. — *C. vulpina*, Carey, etc., not L. Fort Pierre, South Dakota (Dewey): rare. Readily distinguished by its flat culm.

+ + Beak twice or more the length of the body.

64. **C. stipata**, Muhl. *Cespitose: culms thick and spongy, 1 to 2 feet high, very sharply 3-angled, almost winged, about the length of the broad light green canaliculate rough-edged leaves: spikes 10 to 20, loosely aggregated into an oblong or pyramidal head (1 to 3 inches long), which is somewhat branching or occasionally nearly simple at the base: perigynium lanceolate, finely nerved, the rough beak about twice the length of the rounded base, the whole about twice (or a little more) as long as the scale.* — Pastures and wet places throughout.

65. **C. crus-corvi**, Shuttl. Culms 2 to 4 feet high, stout, sharply angled, leafy and glaucous: leaves 4 to 9 lines wide, glaucous: spikes very numerous, disposed in a large panicle which is 4 to 9 inches long with the lower branches conspicuous and usually long: perigynium peculiarly corky-thickened and truncate at the base, conspicuously few-nerved, the rough and slender beak thrice or more the length of the body, the whole three or four times the length of the inconspicuous scale. — Indian Territory and southward. A conspicuous species with much the aspect of *Panicum crus-galli*.

* * * * Spikes yellow or tawny, aggregated into a long, appressed, compound or rarely simple head: perigynium small, ovate, few-nerved or nerveless,

scarcely longer or shorter than the rough-pointed scale. — **MULTIFLORÆ**, Kunth.

66. **C. vulpinoidea**, Michx. Culms stiff, sharply angled, often scabrous, about the length of the narrow leaves: spikes 8 to 20, forming an interrupted brown or greenish-tawny head an inch or two long and composed of 6 to 10 crowded clusters, one or more of the lower spikes subtended by a short and setaceous or rarely somewhat leafy bract: perigynium diverging at maturity, more or less rough on the angles. — *C. multiflora*, Dew. *C. setacea*, Dew. Colorado (*Vasey*), Nebraska (*Hayden*). A widely variable species, running into a multitude of forms, of which only the following has decisive characters.

Var. **platycarpa**, Gay. Culms mostly rather longer than the leaves; lower sheaths transversely striate opposite the leaves: spikes more scattered, forming a very narrow head, the upper aggregated, the lower distinct and oblong ($\frac{1}{2}$ inch or less long) and very densely flowered and spreading with a truncate top: perigynium larger, orbicular-ovate, winged, nearly green, spreading at nearly right angles to the rhachis. — Indian Territory and probably southwestward.

* * * * * *Staminate flowers variously situated, usually some of the intermediate or terminal spikes all staminate, or the plant entirely dioecious: spikes aggregated in more or less chaffy heads, straw-colored or brown. (The student may seek here No. 72, which has the intermediate spikes staminate, but which is distinguished from all members of this group by its few, erect, and long-lanceolate perigynia.)* — **ARENARIÆ**, Tuckerm.

+ *Spikes short: scales ovate, not awned or conspicuously acute.*

67. **C. siccata**, Dew. *Extensively creeping: culm erect (1 to 2 feet high), sharply angled, rough, mostly longer than the rather narrow leaves: spikes 4 to 12, simple, alternate, ferruginous, longer than the scale-like bracts, the middle ones or sometimes the lower ones all staminate, loosely aggregated into an oblong or cylindrical head (which is $\frac{3}{4}$ to 2 inches long): perigynium green, nerved, the margins slightly incurved, ovate below, contracted into a rough and slightly toothed beak which is longer than the body, the whole longer than the hyaline-margined acute scale.* — Dry places, Colorado and northward. The forms with the lower spikes all masculine resemble those species of the next section with a single terminal spike which is prolonged and staminate at the base.

68. **C. marcida**, Boott. Culm erect, 1 to 2 feet high, sharply angled, scabrous, longer than the narrow leaves: spikes 4 to 15, ferruginous or dark brown, the lower usually somewhat compound, staminate at the apex or nearly dioecious, spreading and imbricated into an oblong-conical or broadly cylindrical head: perigynium brown, becoming very dark at maturity, nerved, ovate or orbicular-ovate, with incurved and serrate margins, contracted into a beak shorter than the body, about the length of, or a little shorter than, the acute or cuspidate scale. — Sandy meadows and mountains throughout.

69. **C. disticha**, Hudson. *Extensively creeping: culm stout, 1 to 3½ feet high, sharply angled, rough above, mostly longer than the leaves: spikes 10 to 25, globose or ovoid, compactly flowered, ferruginous or straw-colored, usually all simple, the middle or terminal ones staminate, loosely aggregated (the two or three lowest sometimes distinct) into a cylindrical or oblong thick and heavy*

head (1 to 3 inches long and 3 to 9 lines wide) which is sometimes subtended by a bract of its own length: perigynium tawny, ovate, prominently nerved, scarcely wing-margined, rough above, shortly beaked (the orifice nearly entire), bearing a conspicuous fissure on the outer side, commonly longer than the acute brown scale. — Dry places, Utah, Colorado, and northward. (Eu.)

70. **C. Gayana**, Desv. Creeping: culms slender (1 to 2 feet high), longer than the leaves: spikes 4 to 15, globose or loosely ovoid, dark brown, simple, nearly diœcious (rarely staminate at the top), rather loosely aggregated into a small ovoid head (8 lines to one inch long): perigynium triangular-obovoid, about as wide as long (sometimes wider), gibbous below, rough on the top, squarely contracted into a very short nearly entire beak, obscurely nerved below, brown and shining at maturity, shorter than the acute chaffy scale. — Colorado and southward.

+ + Spikes mostly nearly linear or narrowly oblong, chaffy: the scales long, attenuated or awned: heads pale.

71. **C. Douglasii**, Boott. Creeping: culm 6 to 12 inches high, obtusely angled and mostly smooth, longer or shorter than the long-pointed leaves: spikes usually many, simple or compound, pale and chaffy, diœcious or nearly so, densely aggregated into a conspicuous and heavy head an inch or two long and often an inch wide, which is sometimes subtended by a setaceous bract of nearly its own length: perigynium ovate-lanceolate, nerved, produced into a slender toothed beak, much shorter and entirely concealed by the long, acute, scarious scale: stamens and stigmas long and conspicuous. — *C. Fendleriana*, Bekler. Var. **minor**, Olney, includes small forms 2 to 6 inches high, with smaller spikes not closely aggregated. Common, especially in Wyoming, Colorado, Utah, and southward. Mature perigynia of this species are rarely seen.

Var. **brunnea**, Olney. Usually taller than the species and more slender (12 to 20 inches high): leaves equalling or exceeding the culm: spikes fewer (3 to 8), the lower distinct, borne in an oblong fuscous head: lower bract short-awned. — Nevada and westward; probably in our region.

§ 15. Spikes staminate at the base. (No. 77 is sometimes diœcious, No. 72 has the central spikes staminate or is rarely diœcious, and No. 78 sometimes has spikes staminate at the top.) — **HYPARRHENÆ**, Anderss.

* Spikes silvery green or tawny when mature, distinct, mostly small: perigynium not wing-margined nor conspicuously broadened, mostly nearly flat on the inner surface. — **ELONGATÆ**, Tuckerm.

+ Perigynium nearly linear or ovate-lanceolate, in loose spikes.

72. **C. bromoides**, Schk. Cespitose: culms usually very slender, 1 to 2 feet high, longer than the narrow and grass-like leaves: spikes 4 to 8, becoming tawny with age, erect, loosely aggregated into a narrow and lax head about an inch long, the middle ones usually staminate, or some rarely staminate at top or bottom (or diœcious), mostly much longer than the inconspicuous scarious bracts: perigynium linear-lanceolate, contracted below, strongly nerved, erect, attenuated into a long rough beak which has a fissure on its outer side, the whole longer than

the lanceolate and acute scale. — Wet places, Cañon City (*Brandegee*) and Middle Park (*Parry*), Colorado.

73. **C. Deweyana**, Schw. Cespitose: culms weak and slender, 1 to 3 feet high, longer than the flaccid and flat leaves: spikes 3 to 6, silvery green, erect, 4 to 8-flowered, the two or three upper ones approximate, the lower more or less remote, the lowest subtended by a setaceous bract of more than its own length, all uniformly staminate at the base: perigynium oblong-lanceolate or ovate-lanceolate, very thin in texture, spongy at the base, nerveless or very nearly so, nearly erect, prolonged into a long and rough toothed beak, little longer than the very acute, or awned white scale. — Moist copses throughout.

Var. **Bolanderi**, W. Boott (*C. Bolanderi*, Olney), with stouter culms, 5 to 10 spikes which are mostly 10 to 30-flowered, nerved perigynium, and mostly hispid-awned scales, may be found westward. It occurs in California and Oregon.

74. **C. elongata**, L. Cespitose: culms very slender, $1\frac{1}{2}$ to $2\frac{1}{2}$ feet high, sharply and roughly angled, about the length of the numerous rough-edged leaves: spikes 8 to 12, oblong, loosely 8 to 30-flowered, somewhat spreading, loosely approximated into an interrupted head, tawny or brown, longer than the almost obsolete bracts: perigynium ovate-lanceolate, firm in texture, strongly many-nerved on both sides, spreading, mostly excurved when mature, narrowed into a nearly smooth rather obtuse point, longer than the obtuse or obtusish broad and white-margined scale. — "Uinta Mountains, shore of a small subalpine lake near the head of Bear River." (Olney in Bot. King Exped.) Readily distinguished by its rusty spikes and spreading strongly nerved perigynia. (Eu.)

+ + Perigynium ovate or nearly so, not sharp-margined, firm in texture, erect in closely flowered and rounded spikes.

75. **C. canescens**, L. Culms slender, 1 to 2 feet high, often weak, rough, about the length or a little longer than the leaves: spikes 3 to 10, pale or glaucous, scattered or remote (the upper usually approximate), small and densely 10 to 20-flowered, obovoid or ellipsoid, mostly conspicuously narrowed at the base with staminate flowers: perigynium small, short-ovate or oval, whitish and granular, mostly obscurely nerved, abruptly and minutely beaked, rather longer than the acutish scale. — *C. curta*, Gooden. Colorado and northward; not common. (Eu.)

Var. **alpicola**, Wahl. Usually more slender: spikes smaller (3 to 9-flowered), usually tawny or brown: perigynium somewhat spreading. — *C. vitilis*, Fries. *C. canescens*, var. *vitis*, Carey. Colorado, Utah, and northward. Including a variety of weak, few-flowered forms, and passing by numerous gradations into the species. (Eu.)

Var. **dubia**, Bailey. Culm stiff (a foot high), longer than the long-pointed leaves: spikes 3 to 6, all approximated at the top of the culm, oblong, 10 to 20-flowered, light tawny: perigynium gradually narrowed into a beak half as long as the body or more, minutely rough on the angles above, nerved, about the length of or a little longer than the scale. — Bear River Cañon, Utah (*Watson*, 1231*). An imperfectly known variety, much resembling the European *C. helvola*, Blytt, from which it differs in its narrower scales, and in the nerved and rough-angled perigynium.

76. *C. lagopina*, Wahl. *Cespitose*: culms 4 to 10 inches high, erect, rather longer than the leaves: spikes usually 3, often 5 or 6, subglobose or ovoid, reddish-brown, compactly flowered, contiguous or the lowest a little remote, all small, longer than the scale-like bracts: perigynium small, obovate or elliptical, usually colored above, thick in texture, nerved, tapering towards the base, often curved, rather abruptly short-beaked, the beak with a closed fissure on the outer side, longer than the ovate, broad, brown, hyaline-margined acute scale. — Uinta Mountains, Utah (Watson). A small alpine species, distinguished by its heads of few dark-colored spikes, its narrow leaves, and cespitose habit. (Eu.)

+ + + *Perigynium* ovate, sharp-margined, firm, often thickened at the base, spreading, in open and at maturity stellate spikes.

77. *C. echinata*, Murr. *Cespitose*: culms sharply angled, smooth or rough, slender and erect (6 inches to 2 feet high), usually longer than the narrow, pale leaves: spikes small, about 8 to 15-flowered, scattered, globular, the upper one conspicuously contracted below with staminate flowers, or rarely all the spikes staminate or all pistillate (*C. sterilis*, Willd.): perigynium ovate or ovate-lanceolate, gradually narrowed into a sharp-edged, rough, toothed beak, nerved, spreading or reflexed, about the length of or longer than the acute scale. — *C. stellulata*, Gooden. Var. *MICROCARPA*, Bcklr. (*C. scirpoides*, Schk., *C. stellulata*, var. *scirpoides*, Carey) includes small and fewer-flowered forms. Twin Lakes, Colorado (John Wolfe); also in Arizona and British America. (Eu.)

* * Spikes tawny or dark, rather large, sometimes crowded: perigynium with a more or less thin or winged margin which is mostly incurved at maturity, rendering the perigynium concave inside. — *OVALES*, Kunth.

+ Spikes aggregated into a more or less dense head.

78. *C. Bonplandii*, Kunth, var. *angustifolia*, Boott. *Stoloniferous*: culm slender and nearly naked (a foot or more high), longer than the grass-like leaves: spikes 3 to 6, small and chaffy, crowded into a small capitulate dark brown head which is a half-inch or less long: bracts scale-like, often setaceously pointed, sometimes inconspicuous, never longer than the head: perigynium ovate or ovate-lanceolate, somewhat colored, narrowed into a serrate beak about as long as the body, nerved, narrowly winged, about the length of the acutish scale or a little longer and about as wide. — *C. Bonplandii*, var. *minor*, Olney. Mountains of Colorado and Utah. The species, which is South American, evidently occurs in California, and the *C. tenuirostris*, Olney in herb, collected in Wyoming by C. C. Parry, may be the same. It is lower and stiffer in habit than the variety with larger heads (which are lighter colored) and a greenish perigynium. Forms of this species appear to unite it with the next, but in general they may be distinguished by the narrowly winged perigynium.

79. *C. festiva*, Dew. *Cespitose*: culms usually slender, 6 inches to 2½ feet high, longer than the flat stem-leaves: spikes 6 to 15, roundish, small, densely aggregated (occasionally somewhat loosely) into a fulvous dark brown or green and brown ovoid head (which is ¼ to 1 inch in diameter): bract usually inconspicuous, sometimes as long as the head, narrow: perigynium varying from broad-ovate at base to long-lanceolate, greenish, conspicuously winged (half its width or more being consumed in the thin margins), narrowed gradually into a

rough beak about as long as the body, *nerved or almost nerveless, longer and broader than the acute or somewhat obtuse brown scale.*—On grassy mountainsides and alpine summits throughout. A variable and widely distributed species. Through its looser forms it approaches No. 84. (N. Eu.)

Var. *Haydeniana*, W. Boott. *Low (4 to 8 inches high): head very dense and dark: perigynium tawny: bracts cuspidate.*—*C. Haydeniana*, Olney. Uinta Mountains, Eastern Utah (*Hayden*).

80. *C. athrostachya*, Olney. Differs from the last in the presence of elongated bracts which are expanded and strongly nerved at the base, the two or three lower much exceeding the mostly paler head: lowest spike rarely distinct.—Colorado (*Vasey*) and Upper Flathead River Valley, Montana (*W. M. Canby*.)

+ + Spikes mostly separated, or if aggregated the individual spikes well defined.

++ Perigynium thin and scale-like, with little distinction between the margin and the body, mostly greenish.

81. *C. lagopodioides*, Schk. Culm stout and leafy, $1\frac{1}{2}$ to 3 feet high, sharply angled, rough above: sheaths of the leaves dilated: spike 7 to 15 or more, mostly large, compactly flowered, mostly obovoid, not pointed, disposed in a loose and heavy long greenish or straw-colored head: bracts filiform or none: perigynium erect, lanceolate, nearly nerveless, with narrow serrate margins, longer than the similarly colored scale.—New Mexico, near Santa Fé (*Fendler*), and probably northward.

82. *C. cristata*, Schw. Differs from the last in its smaller size, fewer, smaller, more densely flowered and more aggregated spikes which are globular: perigynium smaller, spreading at right angles or even reflexed, giving a characteristic cristate appearance to the spikes.—*C. lagopodioides*, var. *cristata*, Carey. Laramie hills, E. Wyoming (*Hayden*), and eastward.

Var. *mirabilis*, Boott, is a form with long and lax culms, broader, orate perigynium with the points loosely conspicuous, and the spikes looser flowered.—*C. mirabilis*, Dew. *C. lagopodioides*, var. *mirabilis*, Olney. Nebraska (*Dewey*), and probably common along our eastern borders. Transition to *C. straminea*, from which it is distinguished by its lax culms and leaves, aggregated and rounded spikes which are green or greenish, and much narrower and thinner perigynia

83. *C. scoparia*, Schk. Culms rather stiff, about as long as the very narrow and long-pointed leaves: spikes 4 to 8, generally aggregated into a close head, club-shaped or ovate, pointed, straw-colored when mature: perigynium elliptic-lanceolate, straw-colored: runs into No. 81.—*C. lagopodioides*, var. *scoparia*, Bcklr. Colorado (*Herb. Olney*), and probably throughout the continent to the east.

++ ++ Perigynium thickened in the middle, with conspicuous wing-margins which are more or less incurved, mostly tawny or brown.

84. *C. leporina*, L. Cespitose: culms erect, 6 to 16 inches high, scabrous above, mostly longer than the leaves: spikes 3 to 6, erect, ovoid, all contiguous into an oblong dark brown head: lower bracts often green and as long as the head, but usually all scale-like: perigynium ovate or ovate-lanceolate, broadly

winged, nerved, rough on the margins, contracted into a beak scarcely as long as the body, the whole not longer than the thin-margined scale. — Colorado, Utah, and northward. (Eu.)

85. **C. Liddoni**, Boott. Culm erect or nearly so: spikes 3 to 6, obovoid or oblong, pointed, erect, chaffy at the base, conspicuously fulvous in color, contiguous, or loosely aggregated into an oblong head (about an inch long): perigynium large and conspicuous, greenish or tawny, firm in texture, lanceolate (4 to 6 lines long), thrice as long as the elliptic brown achenium, few-nerved when mature, rough on the narrowly winged and incurved margins, very gradually beaked, about the length of the acute and thin-margined scale. — *C. adusta*, var. *congesta*, W. Boott. Mostly at high altitudes. South Park, Colorado (*John Wolfe*), and Montana (*F. L. Scribner*); said to occur in Arizona.

86. **C. adusta**, Boott, var. **minor**, Boott. Culm very slender towards the top, weak and nodding at maturity, erect when young: leaves narrow, very long-pointed: spikes all silvery brown, long-attenuated at the base, the lower rather remote: perigynium thin and papery, ovate-lanceolate, nearly nerveless. — *C. pratensis*, Drejer. South Park, Colorado (*John Wolfe*); also in British America.

87. **C. straminea**, Schk. Culms erect, 1 to 2 feet high, mostly stiff, much longer than the erect long-pointed stem-leaves: spikes 3 to 8, all distinct, ovoid or globose, tawny or straw-colored, mostly approximate at the top of the culm: perigynium orbicular or ovate-orbicular, often cordate at base, few-nerved, thin, very widely winged, spreading, abruptly contracted into a smooth or nearly smooth beak which is not longer than the body, much wider and usually longer than the acute scale. — *C. festucea*, Schk. Vars. *festucea* and *aperta*, Boott. Dry banks, New Mexico (*Fendler*), Uintas, Northern Utah (*Watson*), Colorado (*Vasey*), Bitter Root Valley, Western Montana (*Watson*), and eastward; also in British America.

Var. **tenera**, Boott. Top of the culm slender and somewhat nodding: spikes more tawny. — *C. tenera*, Dew. Indian Territory (*Geo. D. Butler*).

ORDER 88. GRAMINEÆ. (GRASS FAMILY.)

Grasses, with usually hollow stems (*culms*) closed at the joints, alternate 2-ranked leaves, their sheaths split or open on the side opposite the blade; the hypogynous flowers imbricated with 2-ranked glumes or bracts; the outer pair (*glumes* proper) subtending the spikelet of one or several flowers; the inner pair (*flowering glume* and *palet*) enclosing each particular flower, which is usually furnished with 2 or 3 minute hypogynous scales. Stamens 1 to 6, mostly 3: anthers versatile. Styles 2 or 2-parted: stigmas hairy or plumose. Ovary 1-celled, 1-ovuled, forming a seed-like grain in fruit. — Roots fibrous. Sheaths of the leaves more or less extended above the base of the blade into a scarious appendage (*ligule*). See *Vasey's Descriptive Catalogue of U. S. Grasses*.

SERIES I. Spikelets articulated with the pedicel below the glumes, and consisting of one fertile terminal flower, and usually an inferior one which is male or sterile. — PANICACEÆ.

Tribe I. Fertile spikelets perfect, rarely by abortion unisexual, spikeate or paniculate: outer glumes usually two, rarely one or none; flowering glume indurated in fruit, or at least more rigid than the outer ones, awnless. — PANICEÆ.

* Branches of the simple panicle spike-like, or variously branched, not produced beyond the spikelets.

1. **Paspalum.** Spikelets in one or two rows along one side of the solitary, subdigitate, or scattered flattened spikes. Glumes 3 (rarely 2), the two outer ones membranous, equal, or sometimes the outer one smaller or disappearing: the flowering glume more or less concave, becoming indurated, embracing the shorter palet, which is of the same texture.

2. **Beckmannia.** Spikelets sessile, crowded in two rows upon the short simple or compound branches of a long narrow panicle. Glumes 3, sub-coriaceous, obovate or boat-shape, compressed and inflated, empty: the flowering glume lanceolate, acute or acuminate, of thinner texture.

3. **Panicum.** Spikelets spikeate or paniculate. Glumes 3 (rarely 2), the two outer ones empty and one of them smaller (often very small) than the other: fertile glume with its palets usually coriaceous in texture and obtuse or obtusish.

4. **Setaria.** Spikelets in a cylindrical spike, or sometimes an interrupted panicle: several bristles below the articulation of the spikelets, which are persistent after the fall of the spikelets. Glumes 3 (rarely 2), the two outer ones empty and membranous, as is also the lower flowering one: the flowering glume, with its palets, indurated and striate.

** Spikelets surrounded by or intermixed with abortive branches of the panicle, forming a bristly involucre, which is deciduous with the spikelet.

5. **Cenchrus.** Spikelets enclosed 1 to 3 together in a coriaceous, spiny involucre or bur: these arranged in an oblong or cylindrical panicle.

*** Spikes one to many on a common peduncle, rachis produced beyond the uppermost spikelet.

6. **Spartina.** Spikelets one-flowered, much flattened, sessile along one side of the long triangular rachis, or in racemose spikes. Outer glumes strongly compressed, with a rigid keel, unequal, awnless: flowering glume membranaceous, compressed, carinate: palet nearly equalling its glume, 2-keeled.

Tribe II. Spikelets usually perfect, or some of them imperfect, articulated in fascicles with the rachis of the simple spike: flowering glumes membranaceous; generally the outer or empty ones smaller and hyaline. — ZOYSIÆ.

7. **Hilaria.** Inflorescence in terminal spikes. Spikelets in small clusters of three, closely sessile at the joints of the rachis; the central spikelet containing a single fertile flower, either female or perfect; the lateral spikelets each with 2 or 3 male flowers.

Tribe III. Spikelets arranged along the rachis of the spike or the branches of the panicle generally in twos, or the terminal one in threes. Flowering glume hyaline, smaller than the empty ones, often bearded. — ANDROPOGONEÆ.

8. **Andropogon.** Inflorescence in simple or paniculate spikes. Spikelets in pairs in the alternate notches of the rachis, one sessile and fertile, the other pedicelled and sterile.

9. **Chrysopogon.** Inflorescence loosely paniculate. Fertile spikelets one-flowered, sessile between two pedicellate sterile spikelets at the end of the slender branches of the panicle, with sometimes 1 to 3 pairs of spikelets on the branch below the terminal three.

SERIES II. Spikelets usually not articulated with the pedicel below the glumes; the rachis continuous above the persistent lower glumes, and disarticulating with the flowers or persisting; consisting rarely of a single flower, or of one perfect and one or

two inferior imperfect ones, or of from two to many flowers, the upper ones or some of them imperfect. The rachis sometimes produced beyond the upper flower as a stipe-like pedicel or as an imperfect flower. — POACEÆ.

Tribe IV. Spikelet one to three-flowered, perfect flower solitary and terminal: glumes one-nerved or keeled (sometimes three-nerved in *Phalaris*). — PHALARIDÆ.

* Rachis articulated above the outer glumes.

10. **Phalaris.** Spikelets one-flowered, compressed, on the densely flowered branches of a panicle (in ours). Outer glumes acute, boat-shaped, becoming coriaceous or cartilaginous; within these the flower consisting of two glumes, sometimes called palets, enclosing stamens and pistil; below the flower one or two small scales or bristles.
11. **Hierochloa.** Spikelets 3-flowered, in an open panicle: terminal flower perfect, but with only 2 stamens; the two lower flowers male only, each with 3 stamens. Two outer glumes thin and scarious, acutely keeled; glumes of the male flowers thicker, sometimes short-awned, each enclosing a narrow, thin, bifid, two-keeled palet; the upper or perfect flower has a one-nerved glume in place of a palet.

* * Rachis articulated below the spikelet.

12. **Alopecurus.** Spikelets one-flowered, crowded in a cylindrical spike. Outer glumes strongly compressed, boat-shaped, keeled, nearly equal, frequently united at base; flowering glume shorter, keeled, with a slender dorsal awn, frequently more or less united below by the opposite margins and enclosing the stamens and styles.

Tribe V. Spikelet perfect, one-flowered; rachis often prolonged beyond the flower as a bristle or stipe. — AGROSTIDÆ.

* Spikelets paniculate: rachis not produced beyond the flower: beard of the flowering glume terminal.

13. **Aristida.** Spikelets in a spicate or open branching panicle, generally on filiform pedicels. Outer glumes unequal, often bristle-pointed: flowering glume narrow, rolled around the flower, terminating with a trifid awn, or apparently 3-awned: palet small and thin, enclosed in the flowering glume.
14. **Stipa.** Spikelets terete. Outer glumes membranaceous, keeled: flowering glume narrow, coriaceous, rigid, involute, with a simple twisted awn from the apex: palet small and thin.
15. **Oryzopsis.** Resembling *Stipa*, but the flowering glume shorter and broader, often oblique at top, and the awn usually short, slender and very deciduous.
16. **Muhlenbergia.** Spikelets small, articulated above the glumes. Outer glumes variable in size, from minute to nearly as large as the flowering glume, sometimes bristle-pointed, keeled, persistent, thin: flowering glume 3 to 5-nerved, rigid or thinnish, mucronate or awned, sometimes with a long capillary awn from the apex between the short teeth; frequently pubescent below: palet about as long as the flowering glume and of the same texture.

* * Spikelets in a dense spike-like cylindrical panicle: rachis produced beyond the flower in a bristle, or naked: flowering glumes awnless, or produced in 1 to 3 straight bristles.

17. **Phleum.** Outer glumes one-nerved, mucronate or short-awned: flowering glume membranaceous, shorter and broader than the outer glumes, truncate and toothed at the apex: palet hyaline, narrow.

* * * Spikelets small, loosely spicate or variously paniculate: rachis not produced beyond the flower: glumes awnless and beardless

13. **Sporobolus.** Spikelets rarely 2-flowered. Outer glumes unequal, the lower one shorter, 1 to 3-nerved: flowering glume mostly longer: palet about equalling the flowering glume and of the same texture, 2-nerved.

* * * * Spikelets small, variously paniculate: flowering glume usually with a more or less twisted dorsal awn, rarely mucronate or awnless.

+ No bristle standing opposite the palet.

19. **Agrostis.** Outer glumes nearly equal or the lower rather longer, 1-nerved, awnless: flowering glume shorter and wider, hyaline, 3 to 5-nerved, awnless, or sometimes

with dorsal awn: palet shorter than flowering glume, often reduced to a small scale or wanting. Stamens 3.

20. **Cinna**. Spikelets much flattened, in an open spreading panicle. Outer glumes strongly keeled, hispid on the keel, the upper somewhat longer: flowering glume stalked above the outer glumes and about the same length, 3-nerved, short-awned on the back near the apex: palet nearly as long as its glume, one-nerved. Stamen one.
21. **Ammophila**. Outer glumes large, nearly equal, rigid, thick, keeled, 5-nerved: flowering glume similar in texture, about equal in length, sometimes mucronate: palet as long as its glume, of similar texture, 2-keeled and sulcate between the keels. Hairs at the base of the flower usually scanty and short.

+ + A glabrous or hairy bristle standing opposite the palet.

22. **Deyeuxia**. Outer glumes about equal, keeled, awnless: flowering glume usually with a ring of hairs surrounding its base, entire or 2 to 4-toothed, usually with a dorsal awn: palet narrow, 2-nerved and 2-keeled.

Tribe VI. Spikelets 2 to many-flowered, often paniculate: flowering glumes commonly with a dorsal or terminal geniculate awn: rhachis more or less produced beyond the flowers. — **AVENÆÆ.**

23. **Deschampsia**. Spikelets 2-flowered, mostly in a loose panicle with slender branches. Rhachis hairy and produced into a hairy bristle, which rarely bears an empty glume. Outer glumes acute, keeled, with scarious margins: flowering glumes obtuse or toothed, with a fine dorsal awn below the middle: palet prominently 2-nerved, often 2-toothed.
24. **Trisetum**. Spikelets 2 to 5-flowered, in a dense or open panicle. Rhachis usually hairy and produced into a bristle at the base of the upper flower. Outer glumes unequal, keeled, with scarious margins: flowering glumes of similar texture, keeled, 2-toothed at apex, the teeth sometimes prolonged into bristle-like points, the middle nerve furnished with an awn attached above the middle, which is usually twisted at the base and bent in the middle: palet hyaline, narrow, 2-nerved, 2-toothed.
25. **Avena**. Spikelets unusually large, 2 to 5-flowered, the uppermost generally imperfect, in a loose panicle. Rhachis hairy below the flowers. Outer glumes nearly equal, lanceolate, scarious: flowering glumes firmer, shortly bifid, with a long dorsal twisted awn below the apex: palet as in last.
26. **Danthonia**. Spikelets 3 to many-flowered, in a panicle or simple raceme. Rhachis hairy and produced beyond the flowers in a stipe or imperfect flower. Outer glumes narrow, keeled, usually as long as the spikelet: flowering glumes convex on the back, 7 to 9-nerved, with two terminal teeth or lobes, and with a flattened twisted and bent awn between the teeth: palet broad, 2-keeled, obtuse or 2-pointed.

Tribe VII. Spikelets one to many-flowered, sessile and secund in two rows along the rhachis of one-sided spikes. — **CHLORIDÆÆ.**

* One fertile flower in each spikelet.

27. **Schedonnardus**. Spikelets one-flowered, solitary at each joint of the slender triangular rhachis of the paniculate spikes, and partly immersed in an excavation: the spikes alternate and distant. Outer glumes acuminate, unequal, the longer equalling the flowering glume, which is linear-acuminate and thickish at the keel.
28. **Bouteloua**. Spikes numerous in a racemose panicle: spikelets densely crowded, each consisting of one perfect flower, and a stalked pedicel bearing empty glumes and 1 to 3 stiff awns. Outer glumes unequal, acute, keeled: flowering glume broader, usually thicker, with 3 to 5 lobes, teeth, or awns.

** Two to many fertile flowers in each spikelet.

29. **Buchloe**. Spikelets dioecious, or rarely monœcious, heteromorphous. — *Male plant.* Spikelets 2 to 3-flowered in 2 or 3 short spikes at the summit of the culm, 5 or 6 closely approximated in each spike. Outer glumes unequal, 1-nerved, the lower one half as long as the flower above it, the upper shorter: flowering glumes and paleas of equal length, membranaceous, the former 3-nerved, the latter 2-nerved. — *Female plant.* Spikelets closely approximated in short capitate spikes, which are mostly

near the ground and partly enclosed in the bract-like sheaths of the upper leaves, one-flowered, all the upper glumes indurated and cohering at their bases with the thickened rhachis, the lower glume of the lowest spikelet lanceolate with an herbaceous tip, or 2 to 3-cleft, thickened and adnate to the upper glume, the lower glumes of the other spikelets free, much smaller, membranaceous, one-nerved : flowering glume shorter, 3-nerved, tricuspidate.

Tribe VIII. Spikelets 2 to many-flowered, variously paniculate or rarely racemose : flowering glumes awnless or terminated by one to many awns. — FESTUCACEÆ.

* Glumes 1 to 3-nerved, or rarely many-nerved, 3-toothed, 3-divided, or 3-awned : rhachis glabrous or short pilose.

30. **Triodia.** Spikelets in a strict spicate or open spreading panicle, some of the upper flowers male or imperfect. Outer glumes keeled, awnless : flowering glumes imbricated, rounded on the back, at least below, hairy or smooth, 3-nerved, either mucronate, 3-toothed, or 3-lobed at the apex, or obscurely erose : palet broad, prominently 2-keeled.

31. **Diplachne.** Spikelets narrow, sessile or nearly so, distant on the long slender branches of the panicle, usually in two rows. Outer glumes keeled, awnless : flowering glumes 1 to 3-nerved, with a thin shortly 2-lobed apex, the keel produced into a short point or awn between the lobes : palet thin, prominently 2-nerved.

32. **Triplasis.** Panicle simple and scanty, partly included in the leaf-sheath. Spikelets remotely 2 to 5-flowered. Outer glumes much shorter than the flowers, 1-nerved : flowering glumes 2-lobed or 2-cleft, 3-nerved, strongly fringed on the nerves, the mid-nerve extended into an awn between the lobes : palet shorter, 2-keeled, long ciliate on the keels.

** Tall grasses with a many-flowered panicle : flowering glumes 3-toothed, or 1 to 3-awned : rhachis or the flowering glumes long pilose.

33. **Phragmites.** Flowers rather distant, silky, villous at the base and with a conspicuous silky-bearded rhachis, all perfect but the lowest flower of the spikelet, which is male and glabrous. Outer glumes narrow, unequal, glabrous, keeled : flowering glumes slender, awl-pointed : palets much shorter, 2-keeled, pubescent on the keels.

*** Spikelets capitate : flowering glumes 3 to 5-nerved.

34. **Munroa.** Spikelets 2 or 3 together in small sessile leafy heads or clusters terminating the numerous fasciculate and lateral branches, and at the nodes, each about 3-flowered, the upper flower imperfect. Outer glumes shorter than the flowers, 1-nerved : flowering glumes larger, rather rigid, 3-nerved, entire or 2-toothed, the central nerve excurrent in a mucro or short awn.

**** Spikelets variously paniculate : flowering glumes mostly 3-nerved, rarely 1-nerved.

35. **Koeleria.** Spikelets 3 to 5-flowered, compressed, numerous in a dense spike-like cylindrical or interrupted panicle. Outer glumes unequal, keeled, lanceolate, about as long as the spikelet : flowering glumes similar, rarely mucronate, the upper one usually smaller and imperfect.

36. **Eatonia.** Spikelets usually 2-flowered and with an abortive rudiment or pedicel, numerous in a contracted or slender panicle, very smooth. Outer glumes unequal ; the lower narrowly linear, keeled, 1-nerved ; the upper broadly obovate, shorter than the spikelet, not keeled, 3-nerved : flowering glumes oblong, obtuse, chartaceous.

37. **Catabrosa.** Spikelets 2 to 3-flowered, in a loose panicle. Outer glumes unequal, shorter than the flowers ; the lower short and narrow ; the upper obovate, 3-nerved, erosely-dentate at the apex : flowering glumes obtuse, prominently 3-nerved.

38. **Eragrostis.** Spikelets usually many-flowered, pedicellate or sessile in a loose and spreading or narrow and clustered panicle. Outer glumes unequal and rather shorter than the flowering ones, keeled, 1-nerved : flowering glumes obtuse or acute, unawned, 3-nerved, with prominent keel and the lateral nerves sometimes very faint.

* * * * * Flowering glumes 3 to 5 or many-nerved, more or less involute, the upper two or more empty or imperfect.

39. **Melica.** Spikelets 2 to many-flowered, usually convolute around each other, the upper 1 to 3 smaller and imperfect. Outer glumes awnless, the lower 3 to 5-nerved, the upper sometimes 7 to 9-nerved, the lateral nerves vanishing within the scarious margin: flowering glumes thicker, rounded or flattish on the back, 5 to 9-nerved, the lateral nerves vanishing below the apex, the central one sometimes ending in a point or awn: palea ciliate on keels and apex.

* * * * * Flowering glumes 5 to many-nerved, the upper one empty, style short, stigmas plumose: leaves generally narrow, without transverse veins.

40. **Distichlis.** Spikelets dioecious, many-flowered, compressed, crowded in a dense spike or capitate or rather open panicle. Outer glumes herbaceous, narrow, keeled: flowering glumes rigidly membranaceous or subcoriaceous, keeled: keels of the palea narrowly winged.

41. **Poa.** Spikelets somewhat compressed, usually 2 to 5-flowered, in a narrow or loose and spreading panicle, the rachis between the flowers glabrous or hairy, the flowers generally perfect, occasionally dioecious. Outer glumes keeled, 1 to 3-nerved, not awned: flowering glumes 5 to 7-nerved, the intermediate nerves frequently obscure, often with a few loose or webby hairs at the base.

42. **Grappophorum.** Spikelets 2 to 5-flowered, rather terete, in a narrow or loose panicle. Outer glumes nearly equalling the rather remote flowers, keeled, 3 to 5-nerved: flowering glumes rounded on the back or obscurely keeled, faintly or strongly nerved; a tuft of villous hairs at the base of each flower.

43. **Glyceria.** Spikelets several to many-flowered, terete or flattish, in a narrow or diffuse panicle, the rachis smooth and readily disarticulating between the flowers. Outer glumes unequal, 1 to 3-nerved: flowering glumes obtuse, more or less denticulate at the apex, rounded (never keeled) on the back, 5 to 9-nerved, the nerves separate and all vanishing before reaching the apex.

44. **Festuca.** Spikelets 3 to many-flowered, variously paniced, pedicellate, rachis not hairy. Outer glumes unequal, the lower 1-nerved, and the upper 3-nerved, narrow and keeled: flowering glumes narrow, rounded on the back, more or less distinctly 3 to 5-nerved, acute or tapering into a straight awn.

45. **Bromus.** Spikelets 5 to many-flowered, in a dense or lax or diffuse panicle, subterete or compressed, the rachis between the flowers glabrous. Outer glumes more or less unequal, acute, awnless or short mucronate, 1 to 9-nerved: flowering glumes rounded on the back or compressed and keeled, 5 to 9-nerved, acute, or awned from below the mostly 2-cleft apex.

Tribe IX. Spikelets one to many-flowered, sessile on the teeth or excavations of the rachis of the simple stout spike. — HORDEACEÆ.

* Spikelets solitary at the nodes, 3 to many-flowered, rarely 2-flowered.

46. **Agropyrum.** Spikelets compressed, alternately sessile on the continuous or slightly notched rachis. Outer glumes nearly equal and opposite, 1 to 3-nerved, scarcely keeled, tapering to a point or awned: flowering glumes similar, rounded on the back, 3 to 7-nerved, pointed or awned from the apex: the two prominent nerves of the upper palea almost marginal and scabrous ciliate.

* * Spikelets two to many at each joint of the rachis.

47. **Hordeum.** Spikelets 1-flowered, with an awl-shaped rudiment of a second flower, in a dense spike, in clusters of 2 or 3; central spikelet of each cluster perfect and sessile, the lateral ones short-stalked and imperfect or abortive. Outer glumes side by side, two to each spikelet or 6 at each joint, slender and awn-pointed or bristle-form: flowering glume herbaceous, shorter, oblong or lanceolate, rounded on the back, not keeled, 5-nerved, acute or long-awned.

48. **Elymus.** Spikelets 2 to 4 at each joint, sessile, 1 to 6 flowered. Outer glumes two for each spikelet, nearly side by side in its front, forming a kind of involucre for the cluster, narrow, rigid, 1 to 3-nerved, acuminate or awned: flowering glumes herbaceous, oblong or lanceolate, rounded on the back, not keeled, acute or awned.

1. PASPALUM, L.

Ours are perennials, with very obtuse orbicular spikelets and a narrow wingless rhachis.

1. *P. setaceum*, Michx. Stems ascending or decumbent (1 to 2 feet long), slender: leaves and sheaths clothed with soft spreading hairs: spikes very slender (2 to 4 inches long), mostly solitary on a long peduncle, and usually one from the sheaths of each of the upper leaves on short peduncles or included: spikelets narrowly 2-rowed. — Colorado (*Hall & Harbour*), and very common eastward.

2. BECKMANNIA, Host.

A coarse perennial aquatic, with flat scabrous leaves and glabrous sheaths.

1. *B. erucæformis*, Host. Stems stout, 1 to 4 feet high: leaves 4 to 8 inches long; ligules elongated: panicle 4 to 12 inches long, erect, strict, secund, the short crowded branchlets densely flowered from the base: spikelets nearly orbicular, the upper rudimentary floret minute, stipitate. — Widely distributed west of the Mississippi.

3. PANICUM, L. PANIC GRASS.

Panicle sometimes with the inflorescence crowded upon one side of a narrow rhachis. Grasses of various habits, from low and almost prostrate to stout and several feet high.

* *Spikelets disposed in diffuse and spreading panicles, scattered, awnless.*¹

+ *Spikelets pointed.*

1. *P. capillare*, L. *Sheaths and usually the leaves very hairy: panicle half the length of the stem, very open, its long slender branches solitary or in pairs, divaricate when old; spikelets ovoid to narrowly oblong, scattered, on long pedicels: sterile flower neutral and of a single glume, twice the length of the acute 1-nerved lower glume; upper glume 5-nerved, pointed, nearly a half longer than the somewhat obtuse perfect flower.* — An abundant grass from the Atlantic to the Pacific, mostly in sandy soil. Known as "Old-Witch Grass."

2. *P. virgatum*, L. *Taller (3 to 5 feet high) and glabrous: leaves very long, flat: branches of the compound loose and large panicle at length spreading or drooping; spikelets ovate, scattered, usually purplish: sterile flower staminate and of a flowering glume and a single pale; lower glume more than half the length of the upper.* — About Denver, and common in the Eastern States.

3. *P. amarum*, Ell. *Like the last, but much smaller, with stems sheathed to the top, leaves involute, glaucous, coriaceous, the uppermost exceeding the contracted panicle.* — Cañon City (*Brandegge*), and in sandy soil along the Atlantic coast.

¹ *P. sanguinale*, L., an introduced species, has spikelets in pairs, one sessile, the other pedicelled, crowded on one side of four or more simple flattened branches digitately clustered at the top of the stem; the lower glume very minute, the upper half the length of the flower. — Appearing late in the season, and known as CRAB GRASS or FINGER GRASS.

+ + *Spikelets obtuse.*

4. **P. scoparium**, Lam. Stem geniculate at the lower nodes and at length branched and reclining: *leaves lanceolate, mostly erect and somewhat rigid*, hairy beneath and fringed with spreading hairs at base: panicle nearly simple, with slender hairy branches; *spikelets few, large, tumid, obovate*, usually hairy: *upper glume 9-nerved*, twice or three times the length of the lower one: *flowering glume with a transverse fold or furrow near the base.* — *P. pauciflorum*, Ell. ? of Gray's Manual. Colorado, Oregon, and eastward to New England.

5 **P. dichotomum**, L. Stem erect and simple, or late in the season decumbent and variously branched: *lower leaves usually ovate, the upper linear-lanceolate*, smooth or hairy or velvety: terminal panicle open, ovoid, *those of the branches short and often included in the sheaths*; *spikelets oblong-obovate*, smooth or hairy: *upper glume 5 to 7-nerved*, three times the length of the lower one. — Found everywhere, and exceedingly variable.

* * *Spikelets crowded in 3 or 4 rows or irregularly on the one-sided spike-like branches of the panicle.*¹

4. SETARIA, Beauv. BRISTLY FOXTAIL GRASS.

Annuals, with linear or lanceolate flat leaves. Closely related to *Panicum*, but easily distinguished by the bristly appearance of the spike.²

1. **S. setosa**, Beauv., var. **caudata**, Vasey. Stem flattened below, leafy: leaves and sheaths retrorsely scabrous, hairy at the mouth of the sheath, upper leaves involute-pointed: spikes cylindrical, 4 to 6 inches long, often nodding, usually much interrupted below, pale green: bristles upwardly serrulate: perfect flowers ovate, acute, finely punctate. — Grasses U. S. 13. *S. caudata*, R. & S. S. W. Colorado (*Brandegee*) to Arizona, New Mexico, and Texas.

5. CENCHRUS, L. BUR GRASS. HEDGEHOG GRASS.

Annual. A troublesome grass, in sandy localities, the spiny heads being deciduous and parting readily from the stem.

1. **C. tribuloides**, L. Stems branching and ascending: leaves flat: panicle of 8 to 20 spherical heads: involucre prickly all over with spreading and barbed short spines, more or less downy. — Found everywhere, especially on the margins of lakes and rivers.

¹ *P. Crus-galli*, L., very widely introduced, possibly indigenous somewhere on the continent, has stems from an inch or two to five feet high, leaves lanceolate and rough on the margins, panicle mostly dense and pyramidal, often tinged with purple, outer glumes rough upon the nerves and abruptly pointed, glume of sterile flower awl-pointed or short-awned, but mostly with a rough awn an inch long or more. — Known as BARN-YARD GRASS.

² The following species, all of which have bristles in clusters and roughened or barbed upwards, are very commonly introduced: —

S. clausa, Beauv., known by its dense fawny yellow cylindrical spike (2 to 4 inches long), 6 to 11 bristles in a cluster, and perfect flower transversely wrinkled. — FOXTAIL.

S. viridis, Beauv., has a green more or less compound nearly cylindrical spike, few bristles, and perfect flower striate lengthwise and dotted. — GREEN FOXTAIL. BOTTLE GRASS.

S. Italica, Kunth, has thick compound yellowish or purplish nodding spikes (6 to 9 inches long) and 2 or 3 bristles in a cluster. — Sometimes cultivated under the name of MILLET, or BENGAL GRASS.

6. SPARTINA, Schreber. CORD or MARSH GRASS.

Perennials, with simple and rigid reed-like stems, from extensively creeping scaly rootstocks, very smooth sheaths, and long tough leaves.

1. *S. cynosuroides*, Willd. *Stems 2 to 6 feet high: leaves 2 to 4 feet long, tapering to a long slender involute point: spikes 5 to 20, scattered and spreading, at least at maturity, the pedicels and common axis strongly hispid on the angles: lower glume very narrow; the upper broad, spinulose-hispid on the keel and tapering to a rough awn: the flowering glumes very rough on the midrib which terminates just below its tip.*—Across the continent along the borders of lakes and rivers, especially common in the Atlantic States.

2. *S. gracilis*, Trin. *Stems more slender, 1 to 3 feet high, exceeding the spreading distichous rough and rigid leaves: spikes 4 to 10, mostly sessile, closely appressed to the nearly smooth rhachis: outer glumes very unequal, the lower acuminate, the upper acute, they and the flowering glume ciliate and hispid upon the keel.*—Steud. Gram. 214. In saline soils from Oregon to Texas, also in Florida.

7. HILARIA, HBK.

Creeping plants, with spikelets so closely sessile as to require some care in their separation.

1. *H. Jamesii*, Benth. *Stems 1 to 1½ feet high, hairy at the nodes: leaves glaucous, rigid, scabrous, mostly convolute, the upper ones short and pungent; sheaths scabrous, hairy at the throat; ligule lacinate: spike 2 to 3 inches long, erect: outer glumes of the perfect spikelet ciliate, cleft nearly to the middle, the lobes 1-nerved on the inner margin with 3 to 5 intermediate bristles, the central one longer: flowering glume 3-nerved, bifid: palea 2-nerved, slightly bifid: lower glume of the sterile spikelets slightly 2-cleft, awned above the middle; upper glume emarginate, cuspidate*—*Pleuraphis Jamesii*, Torr. Ann. Lyc. N. Y. i. 148. From Texas and New Mexico to S. Colorado and Nevada.

8. ANDROPOGON, L. BEARD GRASS.

Coarse, mostly rigid perennials, with lateral or terminal spikes commonly clustered or digitate, the rhachis hairy or plumose-bearded, and often the sterile and staminate flowers also.

1. *A. furcatus*, Muhl. *Tall, 3 to 4 feet high, the naked summit of the stem terminated by 2 to 5 rigid digitate spikes: spikelets approximated, appressed: hairs at the base of the fertile spikelet, on the rhachis, and on the stout pedicel of the awnless staminate spikelet short and rather sparse: awn of fertile flower long and bent.*—In dry sterile soil from Colorado to Texas, and very common in the Atlantic States.

2. *A. scoparius*, Michx. *Stems 1 to 3 feet high, with numerous paniculate branches: spikes single, scattered, mostly peduncled, very loose, often purplish, silky with lax dull white silky hairs shorter than the flowers: awn of fertile flower twice as long as the flower, twisted or bent.*—In S. Colorado and common eastward.

3. **A. saccharoides**, Swz. *Stems slender, 1 to 3 feet high: spikes in pairs (or fours) on short mostly exserted and loosely paniculate peduncles, densely flowered, very silky with long bright white hairs: fertile flower monandrous, with a capillary awn.* — *A. argenteus*, DC. Probably including also (at least in S. Colorado) *A. Jamesii*, Torr. Colorado and southward.

9. CHRYSOPOGON, Trin. INDIAN GRASS. WOOD GRASS.

A tall simple perennial, with glaucous linear-lanceolate leaves and yellowish or russet-brown and shining spikelets.

1. **C. nutans**, Benth. Stem 3 to 5 feet high, terete: panicle narrowly oblong; the perfect spikelets at length drooping, clothed, especially towards the base, with fawn-colored hairs, lanceolate, shorter than the twisted awn; sterile spikelets small and imperfect, deciduous, or reduced to a mere plumose-hairy pedicel. — *Sorghum nutans*, Gray. Southern Colorado, and common in the Atlantic States.

10. PHALARIS, L. CANARY GRASS.

Ours is a perennial, with broad flat leaves, branched panicle, and glumes not winged on the back.¹

1. **P. arundinacea**, L. Stem 2 to 4 feet high, reed-like: outer glumes open at flowering, 3-nerved, thrice the length of the fertile flower: rudimentary flowers reduced to a minute hairy scale or pedicel. — Wet grounds and river banks across the continent, especially northward.

11. HIEROCHLOA, Gmelin. HOLY GRASS. VANILLA GRASS.

Perennials with flat leaves, the dried plants giving off a pleasant vanilla-like odor.

1. **H. borealis**, R. & S. Stem 1 to 2 feet high, with short lanceolate leaves: panicle somewhat one-sided, pyramidal; spikelets chestnut-color: staminate flowers strongly hairy-fringed on the margins; the flowering glume mucronate or bristle-pointed at or near the tip: fertile flower hairy-fringed at the tip. — From California to Colorado and far northward, thence eastward through the northern border States and Canada to Labrador.

12. ALOPECURUS, L. FOXTAIL GRASS.

Perennials, with the flower clusters contracted into a cylindrical and soft dense spike, whence the name.

1. **A. alpinus**, Sm. *Stem erect, smooth, 6 inches to a foot high: upper leaf much shorter than its inflated sheath: outer glumes rather acute, 3-ribbed, covered on the back with long dense white hairs: flowering glume about equalling the outer ones, the awn exserted more than half its length, slightly bent but not twisted.* — English Fl. i. 81. High mountains of Colorado and northward.

¹ It is probable that *P. Canariensis*, L., is sparingly naturalized within our range, the seed being a favorite food of cage-birds. It may be known by its very dense spike-like panicle and wing-keeled outer glumes.

2. **A. aristulatus**, Michx. *Stem ascending from a decumbent base, 1 to 2 feet high: leaves glaucous: spike about 2 inches long, slender and very pale green: outer glumes obtuse, the flowering one slightly exceeding them, its awn attached just below the middle and barely exceeding it.* — *A. geniculatus*, var. *aristulatus*, Torr. From Colorado to California and Oregon, and eastward across the continent.

13. ARISTIDA, L. TRIPLE-AWNED GRASS.

Stems generally branching; leaves narrow, often involute; spikelets in simple or paniced racemes or spikes; grain linear. All grow in sterile, dry soil.

* *Awns unequal, the middle one longer than the lateral ones.*

1. **A. basiramea**, Engelm. Stems erect, 6 to 15 inches high, slender, much branched at the base, and with short floriferous branches enclosed in the upper leaf sheaths: leaves flat, becoming involute towards the apex, sparsely hairy on the margins below: panicle $1\frac{1}{2}$ to 3 inches long, erect, rather lax, its base sheathed by the upper leaf: glumes linear, unequal, 1-nerved, with a short bristle-like point: flowering glume nearly terete, spotted with black, with a short, acute hairy callus: middle awn about 6 lines long, the lateral ones 4 lines long, spirally twisted below (when mature). — Bot. Gazette, ix. 76. Minnesota, W. Upham, and ranging through the prairie region of the Northwest.

* * *Awns about equal in length.*

2. **A. purpurea**, Nutt. *Stem simple, erect, slender, 6 to 15 inches high: sheaths scabrous, exceeding the internodes, pilose at the throat: panicle slender, 3 to 6 inches long, loosely few-flowered: outer glumes purplish, unequal, bifid and shortly awned: flower densely short-pilose at the pointed base, scabrous above: awns 1 to 2 lines long, not exceeding the flower, scabrous.* — Steud. Gram. 134. From Colorado to Texas and westward to the Great Basin.

Var. **longiseta**, Vasey. With very long awns. — *A. longiseta*, Steud. Colorado and southward to New Mexico and Texas.

3. **A. oligantha**, Michx. *Stems tufted, bearing a loosely few-flowered raceme: leaves short: outer glumes nearly equal, the lower ones 3 to 5-nerved, nearly an inch long: awns capillary, $1\frac{1}{2}$ to 3 inches long, much exceeding the slender flower.* — Colorado and southward, thence eastward to Illinois, Virginia, and the Southern States.

14. STIPA, L. FEATHER GRASS.

Perennials, with narrow involute leaves and a loose panicle of early deciduous florets. Some of the species are called "Bunch Grass." The flower has a hardened, often sharp-pointed and bearded pedicel or stipe at its base, the callus.

* *Awn for a part of its length distinctly plumose with silky hairs.*

1. **S. Mongolica**, Turcz. Slender, a foot high, with filiform leaves and a loose few-flowered panicle: glumes membranous, obtuse, about 2 lines long, not quite equal, purplish: flowering glume scarcely shorter, hairy: the bent awn 6 lines in length. — Mountains of Colorado.

2. **S. pennata**, L., var. **Neo-Mexicana**, Thurber. — Easily distinguished by the awns, which are 6 inches or more long, twisted for $1\frac{1}{2}$ to 2 inches below, the upper part flat and beautifully plumose-pennated. — Gram. Mex. Bound. ined. Extending into S. W. Colorado from New Mexico and Texas.

* * Awn not plumose, often strongly pubescent.

← Panicle loose, open.

3. **S. Richardsonii**, Link. Stem $1\frac{1}{2}$ to 2 feet high, slender: panicle 4 to 5 inches long, with slender few-flowered branches; callus short and blunt: outer glumes pointless, nearly equal, about equalling the pubescent flowering glume; awn 6 to 8 lines long. — Mountains of Montana, Scribner, and northward; Manitoba and north shore of Lake Superior, Macoun; also in Maine.

4. **S. comata**, Trin. & Rupr. Stems 1 to 4 feet high, stout, mostly scabrous: leaves roughened, the radical $\frac{1}{4}$ or $\frac{1}{3}$ the length of the stem: panicle included at base by the upper sheath, 8 to 12 inches long; callus pointed: outer glumes nearly equal, with a long subulate point: flowering glume pubescent with coarse hairs: awn 4 to 6 inches long, scabrous especially above, shining, variously curled and twisted. — Watson, Bot. King Exped. 380. From the Upper Missouri to California, New Mexico, and Nebraska.

← ← Panicle narrow, contracted.

5. **S. spartea**, Trin. Stems $1\frac{1}{2}$ to 3 feet high, rather stout: callus pungently pointed, villous-bearded (when mature): glumes lanceolate, slender subulate-pointed, greenish, longer than the palets which are linear and pubescent below. — From Colorado to the Upper Missouri, thence eastward to Illinois and Michigan.

6. **S. viridula**, Trin. Stems $1\frac{1}{2}$ to 5 feet high, with numerous withered sheaths at base: panicle 6 to 18 inches long; callus very short: glumes ovate, bristle-pointed, sometimes tinged with purple: lower palet with short scattered hairs which form a rather irregular crown, and with 2 very minute hyaline teeth: awn 1 to $1\frac{1}{2}$ inches long, usually twice bent, pubescent below and scabrous above. — Watson, Bot. King Exped. 380. From Colorado to California, Oregon, the Upper Missouri, and British America.

15. ORYZOPSIS, Michx. MOUNTAIN RICE.

Perennials, with rigid leaves and a narrow raceme or panicle. Spikelets rather large.

1. **O. micrantha**, Thurber. Leaves linear-setaceous, involute: branches of the panicle in pairs, many-flowered; spikelets shining, florets smooth, a little shorter than the linear acutish glumes: awn about thrice longer than the glumes: anthers naked at apex. — Steud. Glum. 122. Colorado and southward.

2. **O. cuspidata**, Benth. Stems 1 to 2 feet high, rather rigid and somewhat scabrous: leaves narrow, involute, elongated (2 to 18 inches): panicle frequently included at base, dichotomously branched; the spikelets solitary upon capillary peduncles: outer glumes more or less purple, pubescent, attenuate-rostrate: flowering glumes rigid, densely covered with long white silky hairs: the stout nearly straight awn mostly longer: palet rigid: anthers bearded at apex. — *Eriocoma cuspidata*, Nutt. From the Sierras eastward to Missouri and Texas.

16. MUHLENBERGIA, Schreb. DROP-SEED GRASS.

The grain is lance-oblong and drops enclosed in the palets.

* *Panicles contracted or glomerate.*

+ *Flowering glumes barely mucronate or sharp-pointed.*

1. **M. Mexicana**, Trin. Stems ascending, much branched, 2 to 3 feet high: leaves short and narrow: panicles lateral and terminal, often included at the base, the branches densely spiked-clustered, linear: outer glumes awnless, sharp-pointed, unequal, the upper about the length of the very acute flowering glume. — Wyoming and eastward, where it is very common.

+ + *Flowering glume bristle-awned from the tip.*

2. **M. Wrightii**, Vasey ined. Stems erect, 9 inches to a foot high or more: leaves involute, rather rigid and pungently pointed, scabrous, pale; *sheaths much shorter than the internodes: panicle spike-like, 1 to 3 inches long*, the two or three lowest clusters of spikelets somewhat distant: the glumes and palets scabrous, especially on the midribs; lower glume the shorter, $\frac{1}{3}$ to $\frac{1}{2}$ the length of the flowering glume, *mucronate pointed*; upper glume longer, 1-nerved and short-awned: *flowering glume 1-nerved, tipped by a stout rough awn about $\frac{1}{3}$ the length of the palet.* — Colorado and New Mexico.

3. **M. gracilis**, Trin. Stems erect, rigid, clothed below with withered sheaths, 6 inches to 2 feet high: leaves filiform, convolute, scabrous, with the whole plant pale; *sheaths longer than the internodes: panicle 3 to 6 inches long*, often bronzed or blackish, *very narrow, the erect rays mostly solitary*: lower glume a little the shorter, more or less acute; the upper half the length of the floret, 3-nerved, obtuse, *erose at apex or with several teeth*, some of them with short awns: flowering glume with a short-bearded minute callus, pubescent, often thickly marked with blackish green spots, *terminated by a slender roughish awn 4 to 9 lines long.* — Colorado and southward, thence westward into California.

Var. **breviaristata**, Vasey. Cespitose, low, often growing in ring-like patches: leaves very short and rigid: *panicle short, 2 or 3 inches long, very close: awn about the length of the flowering glume.* — Rothrock, in Wheeler's Rep. vi. 284. Colorado and eastward

4. **M. sylvatica**, Torr. & Gray, var. **setiglumis**, Watson. Stems a foot high, nearly erect: *panicle contracted into a glomerate spike*; the branches solitary and densely flowered, mostly to the base: *outer glumes attenuate into a scabrous bristle: flowering glume with its awn about twice longer.* — Bot. King Exped. v. 378. Colorado and Nevada.

5. **M. comata**, Benth. Stems 1 to 3 feet high, smooth except at the nodes where they are retrorsely pubescent: *leaves flat, roughish on both sides*; lower sheaths equalling the internodes, the upper somewhat shorter: panicle 3 to 4 inches long, *pale green, lead-colored or purplish*, either narrow throughout or lobed below, the lower rays 2 or 3 together, the upper solitary, all very densely many-flowered: outer glumes narrow, very acute, *the lower a little the longer, serrulate on the keel: floret with an oblique callus bearing hairs as long as the floret: flowering glume 3-nerved, with a long (3 to 4 lines), flexuose, rough, often purplish awn.* — *Vaseya comata*, Thurb. From Nebraska to Colorado, Nevada, and California.

* * *Panicle loose and open.*

6. **M. pungens**, Thurb. Stems erect, from 1 to 1½ feet high: *leaves* very pale green, *hard and rigid, terminated by a hardened point*: panicle very open, its solitary rays fasciculately branched just above the base into long 1-flowered divisions: *outer glumes* half as long as the floret, *pointed by a distinct brist'le*: flowering glume acute, the awn a line long or less: *palet* with 2 setose teeth, which, nearly equalling the awn, give the appearance of an undeveloped *Aristida*.—Proc. Philad. Acad. 1863, 78. From S. California to Arizona, Colorado, and Nebraska.

7. **M. gracillima**, Torr. Cespitose, *glabrous*: stem simple, 6 to 12 inches high: *leaves* very narrow, involute, short, mostly in radical tufts: panicle 5 to 6 inches long, pyramidal, capillary; branches sub-solitary, widely spreading: spikelets lanceolate, mostly purplish: *outer glumes* acute, scarcely twice shorter than the paleas: *flowering glume* glabrous, 3-nerved, minutely bifid, with a straight awn of equal length: callus naked. — Whipple, Pacif. R. Rep. iv. 155. Colorado and southward.

8. **M. Texana**, Thurb. Stems *geniculately decumbent, branching*: panicle few-flowered, rays solitary or in pairs, naked below, at last widely spreading: *outer glumes* shorter than the floret, 1-nerved, *setaceous mucronate*: *flowering glume* and *palet* pilose, the former terminated by an awn *thrice its length* and equalled or exceeded by the latter: callus conspicuous, glabrous. — Gram. Mex. Bound. ined. From Colorado to Arizona and Texas.

9. **M. debilis**, Trin. Stems 3 to 18 inches high, *ascending from a geniculate base, branching from the lower nodes*: *leaves* mostly flat, acuminate, puberulent on both surfaces, and with the whole plant purple tinged or dark purple throughout: panicle 2 to 6 inches long, the few mostly solitary rays spreading, distant, a little longer than the interspaces, included below by the upper sheath; floret very early deciduous: *outer glumes* ¼ to ½ its length, equal or the lower slightly shorter, the upper or both eroded at the obtuse or truncate apex: *flowering glume* scabrous throughout, terminated by a slender awn 1 to 1½ inches long. — S. California to Northern Mexico and extending into S. Colorado and eastward.

17. PHLEUM, L. CAT'S-TAIL GRASS. TIMOTHY.

Perennials, with spikes very dense and harsh.¹

1. **P. alpinum**, L. Culms 1 to 2 feet high: sheaths of the upper leaves very loose or inflated, the lower ones close; ligule short: spike ovoid or oblong, rarely more than an inch long, usually purplish: *outer glumes* strongly fringed on the back, bearing an awn about their own length. — In alpine regions throughout N. America, Europe, and Asia.

18. SPOROBOLUS, R. Rr. DROP-SEED GRASS. RUSH GRASS.

Stems wiry or rigid. Leaves usually involute and bearded at the throat, their sheaths often enclosing the panicles. Includes *Vilfa*, Beauv.

¹ *P. pratense*, L., the cultivated "Timothy" and frequently naturalized, can be distinguished from *P. alpinum* by its close sheaths, long ligule, much longer spike (1 to 6 inches), and glumes with scarious margins and green keel, which is ciliate with stiff hairs and prolonged into a rigid rough awn shorter than itself.

* Seed adherent to the pericarp: panicle spiked or contracted. — VILFA.

1. *S. cuspidatus*, Torr. Root perennial: stems and leaves very narrow the latter awl-shaped: panicle exserted, very simple and narrow: outer glumes very acute: flowering glume cuspidate. — *Vilfa cuspidata*, Torr. Colorado and northward; eastward through northern latitudes to Canada and Maine.

2. *S. depauperatus*, Torr. Stems tufted, very slender, 3 inches to 2 feet long, often much branched: leaves very minutely scabrous on the upper surface: panicle $\frac{1}{2}$ to 2 inches long, very narrow, of few secondary distant erect rays, which are branched and flower-bearing nearly to the base: outer glumes obtuse, nearly equal: flowering glume and palea nearly equal, the former obscurely 3-nerved, often with a minute mucro. — *Vilfa depauperata*, Torr. Varying greatly with the locality. From W. Texas and Mexico to the Saskatchewan, Oregon, and California.

3. *S. Wolfii*, Vasey. Stems erect, 1 to 1½ inches high, very slender, branched at the base: leaves mostly radical, short, strongly nerved: spikes simple, few-flowered, terminal and lateral, the lateral ones partly enclosed in the loose sheaths: flowers alternate, pointed: outer glumes membranaceous, obtuse: flowering glume and palea nearly equal in length. — *Vilfa minima*, Vasey, Bot. Wheeler Exped. 283. About Twin Lakes, Colorado.

4. *S. tricholepis*, Torr. Stems erect, simple, terete, 9 to 18 inches high, tufted: leaves glabrous: branches of the oblong rather dense panicle alternate; pedicels longer than the spikelets: outer glumes nearly equal, acutish, $\frac{1}{2}$ shorter than the nearly equal pilose flowering glume and palea: flowering glume 3-nerved. — *Vilfa tricholepis*, Torr. Colorado and southward.

** Seed free from the pericarp: panicle generally open.

+ Outer glumes very unequal.

5. *S. cryptandrus*, Gr. Stems 2 or 3 feet high, usually geniculate and branched below: leaves flat, acuminate, scabrous especially above; sheaths strongly bearded at throat: panicle narrowly pyramidal, more or less enclosed by the upper sheath, 4 to 8 inches long, its rays mostly in pairs, flower-bearing to the base: spikelets lead-colored, short-pedicelled: outer glumes somewhat acute. — *Vilfa cryptandra*, Trin. From Texas and New Mexico to Colorado and Oregon, and eastward to New England.

6. *S. airoides*, Torr. Stems forming large tufts, clothed below by the dead sheaths, 2 to 3 feet high, somewhat rigid, smooth: leaves very pale, coriolate and tapering to a filiform apex; sheaths with a few long hairs at the throat: panicle broadly pyramidal, soon exserted, 6 to 12 inches long, its rays solitary or in pairs, naked below: spikelets brownish, on rather long pedicels: outer glumes rather obtuse. — Marcy's Rep. 399. *Vilfa airoides*, Steud. California to Nebraska and southward to New Mexico and Texas.

+ + Outer glumes nearly equal.

7. *S. ramulosus*, Kunth. Stems tufted, 3 to 9 inches high, very slender and branched below: leaves flat or involute, scabrous on the outer surface: panicle very long for the size of the plant, constituting $\frac{2}{3}$ of its height, the rays mostly solitary rather distant and spreading, the secondary branches 1 to 2 flowered: spikelets less than $\frac{1}{2}$ line long: outer glumes mostly acute-toothed on the margin. — *Vilfa ramulosa*, HBK. From Colorado to Texas, New Mexico, and California.

8. *S. asperifolius*, Thurb. Stems 6 to 15 inches long, branched, decumbent at base and forming broad matted tufts: *leaves* flat, scabrous, especially on the margins and upper surface: *panicle* included at base, 3 to 5 inches long, pyramidal or ovoid in outline, the scabrous rays solitary or in pairs, bearing 3 to 4-flowered capillary branches: *spikelets* less than a line long: *outer glumes* minutely scabrous.—Bot. Calif. ii. 269. *Vilfa asperifolia*, N. & M. From Nebraska to Texas, Mexico, California, and Oregon.

19. AGROSTIS, Linn. BENT GRASS.

Mostly perennials, with slender low culms which form dense tufts. Ours are strictly one-flowered.

* *Palet* present.

1. *A. alba*, L. Stems varying from a few inches to 2 feet high, sometimes decumbent at base: *leaves* flat, short, smooth or roughened; *ligule* short and truncate or long and acute: *panicle* slender, usually spreading when in flower and more or less contracted afterwards, green, purplish, or brownish: *flowering glume* very thin, 3 or 5-nerved, rarely with a short awn: *palet* $\frac{1}{3}$ to $\frac{1}{2}$ the length of the *flowering glume*.—Includes *A. vulgaris*, With. Found in all cultivated regions. *A. vulgaris* differs from *A. alba* principally in the *ligule* of the former being short and truncate and that of the latter elongated and acute, hence they are both here included under the older name of *A. alba*. The form *vulgaris* is often called "Red-top."

2. *A. exarata*, Trin. Stem erect, 1 or 2 feet high or more, at length naked for some distance below the *panicle*: *leaves* mostly erect and flat, the radical 2 to 4 and those of the stem 6 inches long or more, roughish or very rough; *ligule* obtuse, more or less decurrent: *panicle* erect, rather narrow, dense to very dense and crowded, pale greenish, rarely tinged with purple: *flowering glume* $\frac{1}{2}$ to $\frac{1}{3}$ shorter than the *outer glume*, 4 to 5-nerved, and marked on the back by a longitudinal furrow, sometimes awned above the middle: *palet* usually shorter than the *ovary*, sometimes longer.—Common west of the Mississippi and exceedingly variable, so much so that many forms described as distinct species must be included under it.

* * *Palet* entirely wanting or very minute.

+ *Spikelets* awnless or short-awned.

3. *A. perennans*, Tuckerm. Stems slender, 1 to 2 feet high: *leaves* flat: *panicle* at length diffusely spreading, pale green: the branches short, divided and flower-bearing from or below the middle.—In Montana and Wyoming, and very common eastward. Called "Thin Grass."

4. *A. scabra*, Willd. Stems very slender, 1 to 2 feet high: *leaves* short and narrow, the lower soon involute: *panicle* very loose and divergent, purplish, the long capillary branches flower-bearing at and near the apex.—Common throughout the whole continent. Called "Hair Grass" or "Fly-away Grass."

+ + *Spikelets* awned.

5. *A. canina*, L. Stems $\frac{1}{2}$ to 2 feet high: root-leaves involute bristle-form, those of the stem flat and broader: *panicle* 2 to 6 inches long, spreading, the unequal rays in clusters of five below, in pairs or solitary above, roughened, branching above the middle: *spikelets* purple or brownish:

flowering glume exsertly awned on the back at or below the middle.— Found everywhere, and very variable, the mountain forms especially bearing many names. Known as “Brown Bent Grass.”

20. CINNA, L. WOOD REED GRASS.

A perennial grass, with simple and upright somewhat reed-like stems, 2 to 7 feet high, bearing an ample compound terminal panicle, its branches in fours or fives; the broadly linear-lanceolate flat leaves with conspicuous ligules.

1. *C. arundinacea*, L., var. *pendula*, Gray. Stem smooth, with conspicuous brownish nodes: leaves rough on both sides and margins: panicle 8 to 12 inches long, drooping at apex, the capillary rays clustered, distant, flexuose, very unequal, the longer flower-bearing above the middle, very scabrous.— California and northward, thence eastward through Montana to the northern border States.

21. AMMOPHILA, Host.

Perennials, with stout stems from thick running rootstocks. This is represented in Gray's Manual by the *Calamovilfa* and *Ammophila* sections of *Calamagrostis*.

1. *A. longifolia*, Benth. Stems 1 to 4 feet high: leaves rigid, elongated, involute above and tapering into a long thread-like point: branches of the pyramidal panicle smooth: the copious hairs more than half the length of the naked flowering glume and palet.— *Calamagrostis longifolia*, Hook. From Colorado northward, thence eastward to Michigan and Illinois.

22. DEYEUXIA, Clarion. REED BENT GRASS.

Perennials with running rootstocks and mostly tall erect and rigid stems. This genus includes all the species of *Calamagrostis* in the section *Deyeuxia*.

* *Panicle loose and open.*

1. *D. Canadensis*, Beauv. Stems tall, erect, smooth, 3 to 5 feet high: leaves about a foot long, flat, minutely scabrous: panicle 4 to 6 inches long, oblong, the common axis and rays scabrous: spikelets $1\frac{1}{4}$ to $1\frac{1}{2}$ lines long: *outer glumes lanceolate, acute*: flowering glume nearly as long, surrounded by copious white hairs, and awned on the back from near the middle *with a very delicate bristle not much stouter than the hairs*, and usually barely equalling or rarely slightly exceeding the palet.— *Calamagrostis Canadensis*, Beauv. From New Mexico northward and across the continent.

2. *D. Langsdorffii*, Trin. Closely resembling the last, but distinguished by its *longer spikelets* (2 to 3 lines), *attenuate-acuminate outer glumes*, which are often cinereously strigose-pubescent, and its *stouter and usually exserted awn*.

* * *Panicle narrow, the erect branches appressed after flowering.*

3. *D. Lapponica*, Trin. Stem about a foot high: *radical leaves nearly as long; stem leaves much shorter and divergent*, all convolute, rigid and strongly

striate, rough above and on the margins: panicle an inch or two long, very dense: outer glumes ovate, acute: flowering glume acute, lacerate-fringed, with numerous delicate basal hairs longer than in the next; awn very slightly exceeding the glume, attached just above the base, straight. — *Calamagrostis Laponica*, Trin. Rocky Mountains of Wyoming and northward to Alaska.

4. **D. stricta**, Trin. Stem taller: leaves mostly setaceous involute, erect, scabrous on both sides: panicle at first included at base, at length exserted, 2 to 5 inches long, narrow, somewhat lobed, interrupted below: outer glumes ovate-oblong, acute, rough upon the keel and minutely scabrous all over: flowering glume bearing the straight awn at or below the middle and slightly exceeding it: the hairs at the base about two thirds the length. — *Calamagrostis stricta*, Trin. From the mountains of Colorado to California, and eastward along the northern border to Vermont and Canada.

5. **D. sylvatica**, DC. Stems 1 to 2 feet high, clothed at base by crowded dead sheaths: radical leaves reaching nearly to the panicle; stem leaves gradually becoming shorter, all attenuate-pointed, more or less scabrous and involute: panicle enclosed at base when young, spike-like, 3 or 4 inches long, very dense; rays mostly in fives, appressed and like the rhachis very rough: outer glumes ovate-lanceolate, very acute: flowering glume acute, 4-toothed, grooved on the back, its awn attached very near the base, twisted and rough below, bent at the middle, and exserted more than half the length of the glumes: hairs unequal, the longest at the sides about $\frac{1}{4}$ as long as the glume. — *Calamagrostis sylvatica*, DC. Mountains of Colorado, thence northward and westward.

23. DESCHAMPSIA, Beauv. HAIR GRASS.

Perennials, formerly included under *Aira* as a subgenus. The flowering glume is delicately 3 to 5-nerved, and the grain is free.

* Outer glumes barely equalling and mostly shorter than the florets.

1. **D. flexuosa**, Beauv. Stem slender, 1 to 2 feet high, nearly naked above the small tufts of involute bristle-form root-leaves (1 to 6 inches long): panicle small and spreading, its branches capillary: awn longer than the glume, at length bent and twisted. — *Aira flexuosa*, L. Mountains of S. W. Colorado (Brandeggee) and northward; common in the Atlantic States.

2. **D. cæspitosa**, Beauv. Stem tufted, 2 to 4 feet high: leaves flat and linear: panicle 6 inches long, pyramidal or oblong: awn straight, barely equaling the glume. — *Aira cæspitosa*, L. Across the continent and northward to Alaska. Very variable, especially the mountain forms. The dwarf mountain plant, 6 or 8 inches high, with a tuft of short setaceous leaves, is var. *arctica*.

* * Outer glumes longer than the florets.

3. **D. danthonioides**, Munro. Stem slender, from a few inches to 2 feet high: leaves very narrow: panicle very loose and open: outer glumes linear-lanceolate: flowering glume with hairs at base $\frac{1}{2}$ as long, shining below; awn inserted just below the middle, about 3 times its length, light brown, twisted below and geniculate near the middle. — *Aira danthonioides*, Trin. From Texas to Colorado, California, and Oregon.

4. *D. latifolia*, Hook. Stem 1 to 2 feet high: *lower leaves* 2 or 3 inches long, *about 3 lines wide*, flat and smooth: panicle with a few slender rays, which are densely flowered above: *outer glumes ovate-lanceolate: flowering glume with silky hairs* $\frac{1}{2}$ as long or more; awn stout, attached just above the middle, somewhat divergent, exceeding the flowering glume but included by the outer ones. — *Aira latifolia*, Hook. In the Northern Rocky Mountains, and westward into Oregon and Washington.

24. TRISETUM, Pers.

Perennials, resembling the next genus and by some made a section under it. Ours have a dense and spike-like panicle, and a smooth ovary.

1. *T. subspicatum*, Beauv. Stems tufted, 4 inches to 2 feet high, smooth or downy: leaves flat and smooth, or with the loose sheaths pubescent: panicle 2 to 6 inches long, dense and oblong-ovate, or elongated and several times interrupted below: lower glume shorter, the upper about equaling the florets, both ciliate on the keel: flowering glume with a divergent awn about its own length. — In the mountains from Colorado to California and northward; eastward along the northern border to New England.

Var. *molle*, Gray. Stem and foliage minutely soft-downy. — Man. 641. Same range.

25. AVENA, L. OAT.

The grain is oblong-linear, grooved on one side, hairy throughout or at the tip only, free but closely invested by the palea.

1. *A. striata*, Michx. Glabrous and smooth throughout, slender, 1 to 2 feet high: leaves narrow: panicle simple, loose, with spikelets on capillary pedicels: lower glume 1-nerved; the upper 3-nerved: flowers short-bearded at base; the soon bent or divergent awn inserted just below the tapering very sharply cuspidate 2-cleft tip of the palea. — Colorado (*Hall & Harbour*), and in the mountains of New York and New England.

26. DANTHONIA, DC. WILD OAT GRASS.

Ours are perennials, with narrow leaves, hairy sheaths, and a small simple panicle or raceme.

1. *D. Californica*, Boland. Stems sometimes decumbent at base, from $\frac{1}{2}$ to 3 feet high: leaves, especially the lower, convolute and setaceously pointed, with sheaths bearded at the throat: *panicle mostly a simple raceme*: outer glumes mostly purplish with scarious margins, pointed, the upper 5 to 7-nerved: *flowering glume broad, its teeth about half its own length, with marginal tufts of long silky hairs at or below the middle*; awn about equalling the glume. — Proc. Calif. Acad. ii. 182.

Var. *unispicata*, Thurber. Stems 6 inches high or less, *from dense tufts of somewhat hairy leaves, the sheaths of which are densely villous with white spreading hairs, arising in small clusters from white minute papillae: spikelet solitary and terminal (rarely 2 or 3)*. — Bot. Calif ii. 294. Both forms occur in the Rocky Mountains, the Wasatch, and westward to California and Oregon.

2. **D. sericea**, Nutt. Stems not tufted, 1 to 3 feet high: leaves narrow, with *sheaths silky-hairy at the throat: panicle narrow*, the lower rays sometimes 2 to 3-flowered and spreading: outer glumes acuminate, much exceeding the florets: *flowering glumes with very long teeth, and villous with long silky hairs all over or only below and on the margins*. — Gray, Man. 640. Colorado to California; also eastward in the Atlantic States.

27. SCHEDONNARDUS, Steud.

Low and branching, often procumbent, chiefly annuals, with narrow leaves and slender spikes.

1. **S. Texanus**, Steud. Stems $\frac{1}{2}$ to 2 feet high, leafy below, naked and curved above: panicle of 3 to 10 recurved secund distant spikes, 3-angled and rough: outer glumes suddenly narrowing to awn-like points: flowering glume but partly covered by the outer ones. — *Lepturus paniculatus*, Nutt. From Illinois to Texas, Colorado, and California.

28. BOUTELOUA, Lag. GRAMA GRASS.

Very slender grasses, often geniculate at base, with short leaves less than a line broad, and ligule a hairy fringe. — Watson in Proc. Am. Acad. xviii. 178.

§ 1. *Spikes two or more, linear or oblong, more or less falcate, the usually very numerous spikelets pectinately crowded on one side of the rhachis: terminal empty glume usually 3-awned.*

* *Lower glumes villous.*

1. **B. hirsuta**, Lag. Tufted, 8 to 20 inches high: *leaves flat, lance-linear, papillose hairy or glabrous: spikes 1 to 4, oblong-linear, very dense: upper glume hispid with strong bristles from dark warty glands: flowering glume pubescent, 3-cleft: sterile glume and its pedicel glabrous, the 3 awns longer than the glumes and fertile flower*. — Colorado to Mexico, and eastward to Texas and Illinois.

2. **B. oligostachya**, Torr. Glabrous, 6 to 18 inches high: *leaves very narrow: spikes 1 to 5, oblong-linear, very dense: glumes sparingly soft-hairy: pedicel of the sterile glume copiously villous-tufted at the summit; the 3 awns equalling the larger glume*. — Gray, Man. 621. From the Saskatchewan to Texas, Mexico, and S. California.

* * *Lower glumes glabrous.*

3. **B. polystachya**, Torr. Stems 3 to 15 inches long: leaves scabrous: *spikes 3 to 6 or more, narrowly linear, dense, the scabrous rhachis hispid-ciliate: flowering and sterile glumes 3-awned, with usually broad lobes between the awns* — Pacif. R. Rep. v. 366. From S. Colorado to S. California, Mexico, and Texas.

4. **B. eriopoda**, Torr. *Spikes more loose and slender: flowering and sterile glumes 1-awned, bearded at base: peduncle villous*. — S. Colorado (Brandegee) to New Mexico and W. Texas.

§ 2. *Spikes numerous, usually short, straight, not pectinate, in a long and virgate one-sided spike or raceme: terminal empty glume rudimentary.*

5. **B. racemosa**, Lag. Stems tufted, 1 to 3 feet high: leaves narrow: spikes $\frac{1}{2}$ inch long or shorter, nearly sessile, 30 to 60 in number in a loose general spike (8 to 15 inches long): sterile glume reduced to a single small awn, or mostly to 3 awns shorter than the flower. — *B. curtipendula*, Torr. From Colorado and Arizona to Texas and northeastward.

29. BUCHLOË, Engelm. BUFFALO GRASS.

A densely tufted grass, forming broad mats and spreading by stolons: stems of the female plant much shorter than those of the male. The two forms, at first described as different genera, were shown to be related by Dr. Engelmann.

1. **B. dactyloides**, Engelm. Flowering stems of the male plant 4 to 6 inches long, glabrous or slightly hairy: leaves 2 to 4 inches long: spikelets alternate in 2 rows, uppermost abortive, bristle-form: stems of the female plant much shorter than the leaves, $1\frac{1}{2}$ to 2 inches high. — Trans. St. Louis Acad. i. 432. On the elevated plains from British America to Texas and New Mexico. One of the many "Buffalo Grasses," but probably one of the most widely distributed and valuable grasses of the plains.

30. TRIODIA, R. Br.

Stems tufted: leaves very narrow and taper-pointed; sheaths bearded at the throat: panicle simple or compound; spikelets often racemose, purplish.

1. **T. mutica**, Benth. Stem rigid, erect, very simple, a foot high: leaves convolute-filiform, 3 to 6 inches long: panicle much exserted, racemose, with short appressed branches; spikelets 5 to 8-flowered: outer glumes rather acute, scarcely half the length of the florets: flowering glume awnless, entire or bifid, long-ciliate on the margin and back. — *Tricuspis mutica*, Torr. Bot. Whipple, 156. From Texas to Arizona, and extending into S. Colorado.

2. **T. pulchella**, HBK. Stems crowded, wiry, 2 to 6 inches high, fasciculately branched above: leaves setaceously convolute, rigid, scabrous; radical leaves crowded, an inch long; upper leaves shorter, the uppermost even appearing like large awned glumes: panicle of about 3 spikelets, 6 to 7-flowered: outer glumes white, acuminate or subulate-pointed, the upper slightly exceeding the lower and the florets: flowering glume white, densely silky-villous to near the middle, deeply bifid, with a strong awn slightly exceeding the obtuse lobes. — *Tricuspis pulchella*, Torr. Pacif. R. Rep. iv. 156. From W. Texas to S. Colorado, Utah, Arizona, and S. California.

3. **T. acuminata**, Benth. Stems simple, 6 inches or more high, usually with but a single node, which bears a very short leaf: radical leaves an inch or two long; those of the stem shorter: panicle dense, ovoid, 1 to 2 inches long, with a few erect branches; spikelets 8 to 12-flowered: outer glumes acuminate, the upper subaristate: flowering glume scarcely bifid, with a central seta $\frac{1}{2}$ its length, densely silky below, with a conspicuously silky tuft near the

base. — *Tricuspis acuminata*, Munro. From Texas to Arizona, and extending into S. Colorado.

31. DIPLACHNE, Beauv. SLENDER GRASS.

Ours are annuals, with flat leaves and geniculate-decumbent and branching stems.

1. *D. fascicularis*, Beauv. Smooth: leaves longer than the stems, the upper sheathing the base of the crowded panicle-like raceme, which is composed of many strict spikes: spikelets short-pedicelled, 7 to 11-flowered: flowering glume hairy-margined towards the base, with two small lateral teeth as well as the short awn. — *Leptochloa fascicularis*, Gray, Man. 623. From New England across the continent.

32. TRIPLASIS, Beauv. SAND GRASS.

A tufted grass, with numerous bearded joints, and short involute-awl-shaped leaves.

1. *T. purpurea*, Chap. Stems ascending, 6 to 12 inches high: panicles very simple, of few spikelets, the terminal one usually exserted, the axillary ones included in the commonly hairy sheaths: awn much shorter than its glume, seldom exceeding the eroded-truncate or obtuse lateral lobes. — *Tricuspis purpurea*, Gray. Colorado (*Hall & Harbour*); about the Great Lakes and along the Atlantic coast.

33. PHRAGMITES, Trin. REED.

Tall and stout perennials, with numerous broad leaves and a large terminal panicle, the silky hairs of the rhachis becoming very conspicuous as the seed ripens.

1. *P. communis*, Trin. Stems 5 to 12 feet high: panicle loose, nodding; spikelets 3 to 5-flowered; flowers equalling the wool. — Found everywhere along the margins of streams and ponds. Looks like Broom-Corn at a distance.

34. MUNROA, Torr.

Creeping annuals, very much branched from the base, with fasciculate branches.

1. *M. squarrosa*, Torr. Leaves 1 to 2 inches long, flat, 1 to 2 lines wide, somewhat pungent, scabrous on the margin: spikelets mostly 3: glumes almost unilateral, linear-lanceolate, keeled. — Bot. Whipple, 158. On the plains.

35. KCLERIA, Pers.

Tufted grasses, with simple upright stems: the sheaths often downy.

1. *K. cristata*, Pers. Panicle narrowly spiked, interrupted or lobed at the base: spikelets 2 to 4-flowered: flowering glume acute or mucronate: leaves flat, the lower sparingly hairy or ciliate. — From California and Oregon eastward to Pennsylvania.

36. *EATONIA*, Raf.

Perennial, slender grasses, with simple and tufted stems, and often sparsely downy sheaths, flat lower leaves and small greenish (or purplish) spikelets.

1. *E. obtusata*, Gray. Panicle dense and contracted, somewhat interrupted, rarely slender: spikelets crowded on the short erect branches: upper glume rounded-obovate, truncate-obtuse, rough on the back. — Manual, 626. Across the continent, occurring most abundantly in the southern part of our range.

37. *CATABROSA*, Beauv.

Glabrous creeping aquatics, with flat leaves, elongated membranous ligules, and diffusely branched panicles with semi-verticillate branches: flowers jointed at base and deciduous.

1. *C. aquatica*, Beauv. Stems 4 inches to 2 feet high, rather stout, ascending: leaves 2 to 6 inches long, 2 to 4 lines wide, scabrous on the margin: panicle uniform, branchlets numerous, divided: flowers light-brown: glumes purplish. — In the Rocky Mountains.

38. *ERAGROSTIS*, Beauv.

Stems often branching: leaves linear, frequently involute, and the ligule or throat of the sheath bearded with long villous hairs.¹

1. *E. Purshii*, Schrad. Sparingly branched at the decumbent base, then erect, $\frac{1}{2}$ to 2 feet high: leaves narrow, flat and soft: panicle elongated, the branches widely spreading, very loose; spikelets 5 to 18-flowered, oblong-lanceolate, at length linear, mostly much shorter than their capillary pedicels: glumes ovate and acute, the flowering glume 3-nerved. — From Nevada, Colorado, and New Mexico eastward to New Jersey.

39. *MELICA*, L. MELIC GRASS.

Perennials with soft and flat leaves: panicle simple or sparingly branched; the rather large spikelets racemose-one-sided. Ours belong to § *EUMELICA*, in which the spikelets are 4 to 8 lines long, with 2 to 8 perfect florets; flowering glume apparently many-nerved below (at least when dry), with a broad scarious margin above. — Scribner, Proc. Philad. Acad., 1885, p. 40.

* *Stems not bulbous at base.*

1. *M. Porteri*, Scribner. Panicle narrow, the slender branches erect, or the lower slightly divergent, the pedicels flexuose or recurved, densely pubescent: empty glumes very unequal and decidedly shorter than the 3 to 5-flowered spikelets. — Rusby's Arizona Plants. *M. mutica*, var. *parviflora*, Porter.

¹ *E. poaeoides*, Beauv., var. *megastachya*, Gray, is a very common introduced species, and may be recognized by its large, short-pedicelled, densely-flowered (10 to 50), flat, lead-colored spikelets, which become linear and whitish when old, forming a narrow crowded panicle; its diffusely spreading habit, and its mostly glabrous sheaths. It is said to emit an unpleasant odor.

E. pilosa, Beauv., is another introduced species, like *E. Purshii* in general habit, but may be distinguished by its spikelets about equalling their pedicels, its obtuse glumes, and the 1-nerved flowering glume.

M. stricta of Brandegee's Fl. S. W. Colorado. From Colorado to Arizona, New Mexico, and Texas.

* * *Stems usually bulbous at base.*

+ *Second glume decidedly shorter than the third.*

2. ***M. spectabile***, Scribner. Panicle nodding, loosely few-flowered, the slender branches erect spreading; terminal floret acute: flowering glume very broadly acuminate, obtuse or notched at the tip. — Proc. Philad. Acad., 1885, p. 45. *M. bulbosa* of Bot. King Exped., and Fl. Colorado. This differs from *M. bulbosa*, Geyer, in its usually taller and more slender stems, more open and nodding panicle, more slender and flexuose pedicels, shorter empty glumes, and broader flowering glumes which taper abruptly to a rounded and usually two-lobed summit. In the mountains, from Colorado and Utah to Montana and Idaho.

+ + *Second glume as long as the third.*

3. ***M. Californica***, Scribner. Panicle erect, *densely many-flowered*, branched below, spicate above; *spikelets about 4 lines long, with about three perfect florets, the rudimentary one obtuse.* — Loc. cit. p. 46. *M. bulbosa* of Bot. California. From the Upper Yellowstone (*T. C. Porter*), where the stem may lack the bulbous character, to California.

4. ***M. bulbosa***, Geyer. Stems singly or densely tufted, usually about 2 feet high, simple: sheaths and upper surface of the leaves scabrous: panicle erect, the branches appressed, *few-flowered*; *spikelets 5 to 6 lines long, with 5 to 8 perfect flowers, the terminal floret acute.* — From Utah and Montana to Oregon and Washington.

40. **DISTICHLIS**, Raf. SPIKE GRASS.

Perennials with widely creeping rootstocks and short stems clothed to the top with crowded sheaths: leaves rigid, mostly involute: pistillate spikelets much more rigid than the staminate.

1. ***D. maritima***, Raf. Stems 6 to 18 inches high, sometimes branched below: leaves about 4 inches long, usually distichously spreading, long-acuminate: spike oblong, 1 to 3 inches long; spikelets 5 to 12-flowered. — Journ. Phys. lxxxix. 104. *Brizopyrum spicatum*, Hook. & Arn.

Var. ***stricta***, Thurber. Leaves setaceous-convolute: panicle loose; spikelets few, erect, often an inch long, 10 to 20-flowered. — Bot. Calif. ii. 306. From Mexico northward throughout the Rocky Mountains, and westward to California.

41. **POA**, L. MEADOW GRASS.

Stems tufted from mostly perennial roots: leaves smooth, usually flat and soft.

§ 1. *Flowering glume rounded on the back, obtuse.*

1. ***P. Californica***, Munro. Densely tufted perennial, its somewhat rigid stems 4 inches to 2 feet high: *radical leaves about half as long as the stem, mostly flat*; stem-leaves short, the uppermost often reduced to a mucro: panicle 2 or 3 inches long, narrow or linear, or with the rays spreading; spikelets 3 to

P. andina, Nutt. glumes acute, rough on the back: flowering glume with a regularly erose apex, the lower half of the middle and marginal nerves ciliolate. — *P. andina*, Nutt., not of Trin. From California to W. Mexico, Colorado, and southward.

2. *P. tenuifolia*, (Nutt.) Scribn. & Smith. — Leaves 1 to 2 long, 1/4 to 1/2 wide, linear-lanceolate, acuminate, glaucous above, pale beneath, very narrowly linear mucronate-pointed leaves; stem-leaves scarcely wider: panicle 2 to 4 inches long, the lower part forming a dense, upright, branched, raceme, the upper part a loose, branched panicle. It is a native of the mountains of the Rocky Mountains, and is found in the mountains of the Pacific coast, from the mouth of the Columbia to the mouth of the San Francisco Bay. — Found in California and Oregon. One of the most valuable of the "Bunch Grasses."

2. Flowering glume compressed-keeled, acute.

* *Loose and spreading, or tufted alpine species, flaccid or rigid.*

— First annual: branches of the short panicle single or in pairs.

♂ *P. annua*, 1. (From West Texas leg. between Del Rio and El Paso, 1900.) — *P. annua* is a common species in the southern part of the range of *P. annua* in the West. It is found in the same localities as *P. annua* and is found in the same quantities. It is found in our southern border in Arizona, New Mexico, W. Texas, etc.

tened: panicle simple and contracted.

4 *P. compressa*, L. (Rust and Grasses, the "Wire") has its base and roots prostrate, and the leaves and culms mostly in pairs, opposite and sessile. It is a hard, erect, 1-2 foot tall plant, and grows as the northeast, and common eastward in sterile soil. Known as "Wire Grass."

Low mountain or alpine species, erect in perennial tufts.

Leaves broadly linear, short and flat, short-pointed; ligule elongated.

5. *P. alpina*, L. Root and stem woody or nearly so, bran to the base; leaves narrow, linear, 1 to 2 lines wide, 1 to 2 inches long, 1½ to 2 inches long, 1½ to 3 lines wide: panicle short and broad; spikelets broadly ovate, 3 to 5-flowered. — Frequent in the mountains and extending northward and eastward. Extremely variable, some of the numerous forms being described as varieties.

→ → Leaves narrowly linear or subulate.

6. *P. laxa*, Henke. Soft and smooth as in the last: stems slender, 3 to 4 feet high. Leaves narrow, linear-lanceolate, mostly parallel to the raceme-like, narrow, often 1-sided and nodding; spikelets 2 to 4-flowered. — In the Valley of the Hudson, at the foot of Mt. New York and New England.

P. caesia.—Stems 6 to 20 inches high: leaves short, soon involute: *ligule* short: branches of the panicle 2 to 5 together, very scabrous: spikelets 2 to 5-flowered: outer glumes ovate-lanceolate and taper-pointed. — In the Rocky Mountains and eastward.

The striction, Gray, has a more slender tube, a narrower grayish purple panicle of smaller flowers. — Same range as the type.

* * *Tall perennials (1 to 3 feet), with open oblong or pyramidal panicles, the rather short and rough branches mostly in fives, sometimes in twos or threes.*

8. *P. pratensis*, L. *Stems with running rootstocks, and with the sheaths smooth: leaves dark green, the radical very long, those of the stem short, scabrous on the margins; ligule short and blunt: panicle pyramidal; spikelets 3 to 5-flowered, somewhat crowded and almost sessile: outer glumes acuminatè, scabrous on the keel: flowering glume distinctly 5-nerved, silky-hairy on the margins and keel.*—Across the continent, and one of the most valuable of pasture and meadow grasses. Known variously as “June Grass,” “Green Meadow-Grass,” “Spear Grass,” and “Kentucky Blue-Grass.”

9. *P. serotina*, Ehrh. *Stems tufted, without distinct running rootstocks: leaves narrowly linear, soft and smooth; ligule elongated, acute: panicle 6 to 10 inches long, at length somewhat nodding at apex, often purplish; spikelets 2 to 4-flowered, all short-pedicelled: outer glumes narrow: flowering glume very obscurely nerved.*—From the Rocky Mountains eastward across the continent. Quite variable, some Rocky Mountain forms having been described as varieties. Known as “False Red-top” and “Fowl Meadow-Grass.”

10. *P. flexuosa*, Muhl, var. *occidentalis*, Vasey. *Stems erect, rather stout, tufted: sheaths mostly smooth; leaves broadly linear, 3 to 5 inches long, gradually tapering to a point, rather scabrous: panicle more diffuse, 4 to 8 inches long; its branches mostly in twos or threes (sometimes fives), long and capillary, smooth or scabrous, diverging, flower-bearing mostly for the upper third: spikelets 4 to 6-flowered: outer glumes acute, thin, slightly hispid on the keel: flowering glume distinctly 3 to 5-nerved, slightly pubescent, rather more so on the keel and margins.*—Bot. Wheeler Exped. 290. Includes *P. flexuosa* (?) of Bot. King Exped. Colorado and Utah.

* * * *Perennials not so tall (1 to 2 feet): branches of the panicle solitary or in pairs.*

11. *P. Eatoni*, Watson. *Allied to the last: stems smooth: sheaths and leaves scabrous; leaves mostly radical and narrowly linear, 3 to 6 inches long, the cauline few and very short: panicle loose and spreading, with short (an inch long or less) branches; spikelets 4 to 6-flowered, purplish: outer glumes acutish: flowering glume very villous on back and margins, obtuse and keeled.*—Bot. King Exped. 386. In the Wasatch Mountains, Utah, Nevada, and S. W. Wyoming.

12. *P. arctica*, R. Br. *Stems erect, slender, very smooth, as are the sheaths and leaves: leaves about two on the stem, narrowly linear, 2 to 3 inches long: panicle 4 to 5 inches long, with longer (lower 2 to 3 inches) capillary branches, which are spreading or reflexed with age: spikelets mostly 3-flowered: outer glumes broadly ovate, rather acute, purple-margined: flowering glume obscurely 3 to 5-nerved, acute, smooth, except pubescent on the keel and lateral nerves.*—In the mountains of Colorado and far northward.

42. GRAPHEPHORUM, Desv.

Perennial and northern or alpine grasses, with linear flat leaves, their sheaths closed at the base, and spikelets in a loose panicle.

1. *G. flexuosum*, Thurber. *Stem 3 feet high, smooth: leaves 1½ feet long, setaceous-acuminatè: panicle loosely flowered; branches scattered; spike-*

lets ovate, 3 to 6-flowered, much shorter than the pedicels: outer glumes 1-nerved, acute, half shorter than the spikelet: flowering glume keeled, 3-nerved (lateral nerves prominent), scabrous-pubescent, erose-denticulate at apex, mucronate, villous at base. — Proc. Acad. Phila. 1863, 78. Plains of Colorado and adjacent regions.

2. *G. melicoides*, Beauv. Stem not so tall, 1 to 2 feet high, smooth above: leaves somewhat scabrous, the lower 4 to 6 inches long, the upper short: panicle loosely flowered, open; spikelets lanceolate, 2 to 4-flowered, with the rachis unilaterally bearded between the flowers: outer glumes quite unequal, acuminate, equalling the spikelet: flowering glume convex, scarcely keeled, faintly nerved, entire, pointless and awnless. — From N. E. Utah and Wyoming northward; found also at isolated stations, as in Michigan and Maine.

3. *G. Wolfii*, Vasey. Closely resembling the last; but the panicle close, almost spicate; the spikelets 2-flowered with a rudiment of a third: outer glumes not so unequal: flowering glume obscurely 5-nerved, slightly split or 2-toothed at apex, bearing near the point a straight appressed awn equalling or a little exceeding the glume. — Bot. Wheeler Exped. 294, as *Trisetum Wolfii*. Colorado.

43. GLYCERIA, R. Br. MANNA GRASS.

Perennial, smooth marsh-grasses, mostly with creeping bases or rootstocks.

* Flowering glume faintly 5-nerved, truncate, erose-toothed or subacute: stigmas with simple hairs.

1. *G. distans*, Wahl. Stems tufted, $\frac{1}{2}$ to 2 feet high: leaves short and narrow, mostly convolute and glaucous: panicle very variable, erect, narrow and one-sided, its rays in fives or fewer; spikelets 3 to 12-flowered: outer glumes from narrow and acute to broad and obtuse, 3-nerved or the lower 1-nerved: flowering glume oblong-linear, minutely pubescent at base, with broadly scarious apex. — *Atropis distans*, Griseb. Includes *G. airoides*, Thurb. *Poa airoides*, Nutt. From New Mexico to Nebraska and westward to the coast; also on the Atlantic coast. This species is very variable, and has been referred to so many genera that its synonymy is quite perplexing.

* * Flowering glume prominently 5 to 7-nerved, truncate-obtuse: stigmas with much branched hairs.

2. *G. nervata*, Trin. Stems 2 to 4 feet high: leaves variable, sometimes 12 to 15 inches long, usually roughish above, as are the closed sheaths: panicle 4 to 8 inches long, its flexuose capillary branches in twos or threes, and soon diffusely spreading and pendulous; spikelets 1 or 2 lines long, 5 to 7-flowered, sometimes purplish: flowering glume 7-nerved, fine scabrous, strongly convex near the apex. — In moist meadows and along water-courses, across the continent.

3. *G. aquatica*, Smith. Stems stout, erect, 3 to 5 feet high: leaves large, 1 to 2 feet long: panicle ample, 8 to 15 inches long, much branched, the numerous branches ascending, spreading with age: spikelets 2 or 3 lines long, 5 to 9-flowered, usually purplish: flowering glume 7-nerved, entire. — In wet grounds, from Colorado to California and Oregon, thence eastward across the continent. Called "Reed Meadow-Grass."

4. **G. pauciflora**, Presl. Stems 1 to $3\frac{1}{2}$ feet high from a creeping root: leaves 3 to 12 inches long, scabrous on the margins; sheaths split: panicle 6 to 8 inches long, loose, its capillary branches in threes below, in pairs above, flower-bearing from near the middle; spikelets 2 to $2\frac{1}{2}$ lines long, 4 to 6-flowered: flowering glume 5-nerved, scabrous, its scarious tip serrulate or toothed, more or less purplish. — From Colorado and Utah northward and westward.

44. FESTUCA, L. FESCUE GRASS.

Includes both slender-stemmed annuals and perennials, the flowers, and often the leaves, being rather dry and harsh.

* *Annuals or biennials with setaceous leaves: panicle contracted or spike-like.*

1. **F. tenella**, Willd. Stems often filiform, 6 to 18 inches high: the erect leaves 1 to 3 inches long; sheaths sometimes pubescent: panicle 2 to 3 inches long, simple, often secund; spikelets, including awns, 4 or 5 lines long, 7 to 13-flowered: outer glumes subulate, very acute, the lower at least half the length of the upper: flowering glume involute, rough, 2 lines long exclusive of its awn, which is mostly shorter than the palet and often very short. — Across the continent.

2. **F. microstachys**, Nutt. Stems 4 to 15 inches high, the filiform leaves, sheaths, etc. smooth to strongly pubescent: panicle 1 to 5 inches long, simple and racemose or spike-like; spikelets 1 to 5-flowered, on short thickened pedicels, from scabrous to smooth: outer glumes acute, the upper little exceeding or twice as long as the lower: flowering glume 2 or 3 lines long, with an awn 3 to 5 lines in length: palet with 2 long setose teeth. — From N. E. Utah to Nevada and westward all along the coast.

* * *Perennials: the mostly short-awned spikelets in loose, or more or less open panicles.*

3. **F. ovina**, L. Stems 6 inches to 2 feet high, glaucous: leaves all setaceous or the upper flat; ligule 2-lobed and auriculate: panicle short, more or less compound, somewhat one-sided, the branches mostly solitary; spikelets 3 to 8-flowered: flowering glume about 3 lines long, terete, mucronate or with an awn less than half its own length. — Mountains of Colorado and California and northward, thence eastward across the continent.

Var. **duriuscula**, Gray. Taller, less densely tufted: stem-leaves often flat and sheaths pubescent: panicle more open and spikelets larger. — Same range as the type.

Var. **rubra**, Gray. Less tufted, with running rootstocks: leaves sometimes flat, and with the spikelets often reddish or purplish. — High alpine form in the Colorado Mountains and far northward.

Var. **brevifolia**, Watson. Stems 4 to 8 inches high: leaves all setaceous and sheaths glabrous; uppermost leaves often very short and the sheaths rather loose: panicle racemose and nearly simple, 1 to 2 inches long; spikelets 1 to 4-flowered, the florets terete and twice the length of the awn. — Bot. King Exped. 389. Same range as the last.

4. **F. scabrella**, Torr. Stems 1 to 3 or 4 feet high, crowded below with leafless sheaths, and twice longer than the numerous scabrous radical leaves: stem-leaves rarely more than 2, long-pointed; sheaths scabrous or rough-pubes-

cent; ligule a ciliate fringe: panicle 3 to 6 inches long, the lower rays distant in pairs; spikelet 4 to 6-flowered: flowering glume 5-nerved, rough, with a narrow scarious margin, pointed, or with an awn a line long or less. — *F. Thurberi*, Vasey. *Melica Hallii*, Vasey, is an alpine form. In the Rocky Mountains and westward. One of the most valuable of the numerous "Bunch Grasses."

45. BROMUS, L. BROME GRASS.

Coarse grasses, with large spikelets at length drooping, on pedicels thickened at the apex. Our indigenous species are perennials.

* *Flowering glume convex or keeled on the back: flowers imbricated over one another before expansion: lower glume 3 to 5-nerved, the upper 3 to 9-nerved.*¹

1. *B. Kalmii*, Gray, var. *Porteri*. Stem 12 to 18 inches high, smooth: sheaths and leaves minutely scabrous: panicle 6 inches long, compound, branches minutely downy; spikelets an inch long, canescent with short appressed silky hairs, 7 to 9-flowered: outer glumes each 3-nerved, obtuse: flowering glume 7-nerved; its awn $1\frac{1}{2}$ lines long — Colorado, at Twin Lakes (*Porter*), Buffalo Peaks, and Sierra Madre Range (*Coulter*).

2. *B. breviaristatus*, Thurb. Stem 2 to 3 feet high: leaves broadly linear, a little hairy; sheaths hairy to villose-tomentose, sometimes even naked: panicle elongated, 3 to 8 inches long, nearly simple, loose; spikelets about an inch long, lanceolate, compressed and sharply 2-edged, minutely scabrous, 6 to 8-flowered: outer glumes acute, lower about 5-nerved, upper 9-nerved: flowering glume acutely keeled, 9-nerved, with an awn 1 to 2 lines long. — *Ceratochloa breviaristata*, Hook. From Colorado northward to Montana and Washington.

* * *Flowering glume somewhat convex, but keeled on the back: flowers soon separating from each other: lower glume 1-nerved, the upper 3-nerved, or with an obscure additional pair.*

3. *B. ciliatus*, L. Tall, 3 to 5 feet high, with the large leaves smooth or somewhat hairy; sheaths often hairy or densely downy near the top: panicle compound, very loose, the elongated branches at length drooping; spikelets 7 to 12-flowered: flowering glume tipped with an awn $\frac{1}{2}$ to $\frac{3}{4}$ its length, 7-nerved, silky with appressed hairs near the margins, smooth or smoothish on the back. — Across the continent and far northward.

46. AGROPYRUM, Beauv.

Perennials, with nearly lanceolate glumes, and 2-ranked spikes; thus differing from *Triticum* (Wheat), although formerly included under that genus.

* *Multiplying by long jointed creeping rootstocks: awn, when present, not longer than the flowering glume.*

1. *A. repens*, Beauv. Stems 1 to 3 feet high: leaves flat or convolute and with sheaths very variable, from smooth to scabrous or pubescent: spike-

¹ The too common "Cheat" or "Chess," *B. secalinus*, L., belongs to this section. It is an annual, with spreading panicle, oblong-ovate turgid smooth spikelets of 8 to 10 rather distant flowers, flowering glume short-awned or awnless, and nearly glabrous sheaths. — Introduced wherever grain is cultivated.

lets 4 to 8-flowered, in an erect mostly rigid spike: glumes 5 to 7-nerved, obtuse or notched, with a rigid short point or awn of variable length: flowering glume similar, but nerved only above, with an awn nearly its own length or awnless. — *Triticum repens*, L. Immensely variable; its many perplexing forms yielding numerous but confusing varieties. Across the continent, and known by a great variety of names, such as "Couch," "Quack," and "Quitch Grass," "Blue-joint," "Bunch Grass," "Lagoon Grass," etc.

* * No running rootstock: flowering glume and sometimes the outer glumes long-awned.

2. **A. caninum**, Reich. Stems 1 to 3 feet high, geniculate below: leaves flat or loosely convolute, pubescent above and like the sheaths smooth below: spike more or less nodding, at least not strict; spikelets 3 to 6-flowered: outer glumes 5 to 7-nerved, with long awns or merely acuminate: flowering glume 5-nerved near the tip, with mostly spreading awns twice as long. — *Triticum caninum*, L. *T. ægilopoides*, Gray, not Turcz. From California to Colorado and Nevada, eastward to New England. Extremely variable.

3. **A. Scribneri**, Vasey. Stems densely tufted, geniculate and usually prostrate, 1 to 1½ feet high: leaves very short (1 to 1½ inches long), smooth, rigid, sometimes glaucous: outer glumes 3 to 5-nerved, extended into a long hispid point: flowering glume with a strong, spreading or recurved hispid awn at least twice as long: otherwise as in the last. — Torr. Bull. x. 128. Possibly only a variety of the last. In the Sierras (Pringle), and Montana (Scribner). High on the mountains, in crevices and among loose rocks.

4. **A. violaceum**, Beauv. Stems slender, 1 to 2 feet high, and with the short mostly convolutely-setaceous leaves and sheaths usually smooth: spike 1 to 3 inches long, slender, strict and rigid; spikelets 3 to 5-flowered, usually purple-tinged: outer glumes with 5 strong rough nerves, short-pointed or short-awned: flowering glume strongly 5-nerved and rough above, with an awn from half to fully as long. — *Triticum violaceum*, Hornem. Rocky Mountains and Sierra Nevada; also mountains of New York and New England.

5. **A. strigosum**, Beauv. Stems slender, 1 to 2 feet high, very densely tufted, with setaceous radical leaves half as tall, glaucous throughout; stem-leaves 3, all narrowly setaceous-convolute, strigose-pubescent on the upper surface, below and with the sheaths smooth or pubescent: spike 2 to 6 inches long, very slender; spikelets 3 to 6-flowered: outer glumes strongly 3 to 5-nerved, somewhat acute: flowering glume 5-nerved near the apex and bearing a longer strong rough divergent awn. — *Triticum strigosum*, Less. *T. ægilopoides*, Turcz. In the mountains of Colorado, Montana, and westward.

47. HORDEUM, L. BARLEY.

Rather low grasses, with flowers in spikes and more or less prominent bristle-form glumes.

1. **H. nodosum**, L. Stems ½ to 3 feet high, often geniculate below: leaves flat or convolute, varying from nearly smooth to hairy: spike 1 to 3 inches long, narrow and readily separating into joints; the lateral neutral spikelets merely awn-pointed: glumes all setaceous: perfect floret 8 lines long including the awn. — *H. pratense*, Huds. *H. pusillum*, Nutt. From California

and Oregon eastward into the Mississippi Valley; introduced on the Atlantic coast.

2. **H. jubatum**, L. Stems 1 to 2 feet high, usually smooth throughout, the margins of the leaves sometimes scabrous: spike very pale green or straw-color, shining, sometimes purplish, 2 to 4 inches long, broader, the very slender rhachis readily separating; *lateral floret short-awned: glumes very long and capillary: perfect floret 3 lines long, with an awn 2 inches long, longer than the glumes and spreading.* — Common westward and northward, extending eastward through the Northern States. Known as "Squirrel-tail Grass."

48. ELYMUS, L. LIME GRASS. WILD RYE.

* *Outer glumes subulate-setaceous, shorter than the spikelet: flowering glume merely cuspidate.*

1. **E. condensatus**, Presl. Stems 2 to 6 feet high or more, with ample mostly flat leaves, smooth except on the margins: spike 5 to 15 inches long, dense or interrupted, simple or frequently made up of fasciated short few-flowered branches; spikelets 3 to 6-flowered: flowering glume 5-nerved above, mucronate-pointed or somewhat 3-toothed. — From Colorado and Nevada to California and Oregon.

* * *Outer glumes acuminate-pointed or awned: flowering glume with an awn longer than itself.*

2. **E. Sibiricus**, L. Stems 2 to 3 feet high: leaves mostly ample, often 6 lines broad, glabrous or partly scabrous: *spike virgate, 2 to 8 inches long, often somewhat nodding above; spikelets in pairs, 3 to several-flowered: glumes linear-lanceolate, 3 to 5-nerved, pointed or short-awned: flowering glume 5-nerved and rough above, with an awn about 1½ times its own length.* — From California and Oregon to Lake Superior.

3. **E. Canadensis**, L. Like the last, but stouter and taller: leaves rougher, sometimes glaucous: spikes stouter, *somewhat loose and more nodding above: outer glumes subulate, 3 or perhaps 4-nerved, tapering into an awn shorter than itself: flowering glume rough-hairy, with a longer usually spreading awn.* — Across the continent.

* * * *Outer glumes very long, usually 2-parted to the base, the divisions unequally 2-cleft and long-awned: flowering glumes long-awned and 2-toothed, or 3-awned.*

4. **E. Sitanion**, Schult. Stems densely tufted, ½ to 2 feet high: leaves and sheaths from smooth and glaucous to roughly hirsute; leaves setaceously pungent at apex, the upper one an inch or two long, its sheath often loose and including the base of the spike: spike 1 to 6 inches long; spikelets 1 to 5-flowered: awns of the outer glumes 1 to 3 inches long: flowering glume 3 lines long, its central awn equalling those of the glumes. — From Minnesota to Texas and westward across the continent. Exceedingly variable, so much so that the collector is apt to discover at least a "new variety" in almost every locality.

CLASS II. GYMNOSPERMÆ.

Ovules naked upon the surface of a scale or bract, or within a more or less open perianth. Flowers monoëcious or diëcious. Cotyledons two or often several in a whorl.

ORDER 89. GNETACEÆ.

Shrubs or small trees, mostly with jointed opposite or fascicled branches and foliaceous or scale-like opposite (or ternate) exstipulate leaves, the flowers mostly diëcious, with decussate persistent bracts; the staminate in aments, with solitary or monadelphous stamens within a membranous bifid calyx-like perianth, the anther-cells dehiscient by a pore or chink at the apex; fertile flowers of an erect sessile ovule terminated by an exserted style-like process, included within a perianth which becomes hardened and often thickened in fruit.

1. EPHEDRA, Tourn.

Inflorescence axillary: the 3 to 8 filaments united into a clavate staminal column. — Shrubs with numerous Equisetum-like branches, the leaves reduced to sheathing scales, persistent or deciduous.

1. *E. Nevadensis*, Watson. Erect, 2 feet high or more; *branches opposite*: scales sheathing, 2-lobed, with short blunt lobes or more or less elongated tips: *bracts opposite and evidently comate*: staminate aments sessile or shortly pedunculate, ovate, of 4 to 6 pairs of bracts: fertile aments pedunculate. — Proc. Am. Acad. xiv. 298. *E. antisiphilitica* of Bot. King Exped. and other reports. From California and Nevada to Utah and the Rio Grande.

2. *E. trifurca*, Torr. Erect, with spinosely tipped ternate branches and conspicuous persistent sheathing acuminate scales becoming white and shreddy: *bracts in threes*: staminate perianth cuneate-oblong, included: fertile aments of numerous whorls of entire bracts. — S. W. Colorado (*Brandegee*), New Mexico, and Arizona.

ORDER 90. CONIFERÆ. (PINE FAMILY.)

Resinous and mostly evergreen trees or shrubs, with awl- or needle-shaped or scale-like mostly rigid leaves, and monoëcious or rarely diëcious flowers; male flowers reduced to stamens only, which are indefinite in number upon a central axis; fertile aments of few or many scales, becoming in fruit a dry cone or berry-like, ovules two or more, at or on the base of each scale.

- * Scales of the fertile aments few, decussately opposite, becoming drupe-like in fruit with bony seeds: leaves opposite or in threes, usually scale-like: flowers dioecious: leaf-buds not scaly.
- 1. **Juniperus.** Ovules in pairs or solitary at the base of the fleshy (4 to 6, or 3 to 9) scales. Seeds 1 to 5 or more. Berry globose, reddish, blue, or blackish, ripening the second year.
- ** Scales of the fertile aments numerous, spirally imbricated, becoming a dry coriaceous cone in fruit: male flowers also spirally arranged: leaves scattered or fascicled, from linear to needle-shaped: flowers monoecious: leaf-buds scaly. — **ABIETINÆ.**
- ← Cones maturing the first year, their bracts remaining membranous: leaves solitary, mostly entire.
- ++ Branchlets smooth, the leaf-scars not raised.
- 2. **Abies.** Leaves sessile, leaving circular scars. Cones erect, their scales deciduous from the axis. Seeds with resin-vesicles.
- 3. **Pseudotsuga.** Leaves petioled, the scars transversely oval. Cones pendulous, their scales persistent on the axis. Seeds without resin-vesicles.
- ++ ++ Branchlets rough from the prominent persistent leaf-bases: cones pendulous, their scales persistent on the axis.
- 4. **Picea.** Leaves sessile, keeled on both sides, with two lateral ducts. Seeds without resin-vesicles.
- ← ← Cones maturing the second year, their bracts becoming corky and thickened: leaves in bundles of 2 to 5, their base surrounded by a sheath of scarious bud-scales usually serrulate.
- 5. **Pinus.** Resin-ducts inconstant in number and variously placed.

1. JUNIPERUS, L. JUNIPER.

The small solitary aments axillary, or terminal upon short lateral branchlets: in staminate flowers the anther-cells are 4 to 8 under each shield-shaped scale: cotyledons mostly 2. — Low shrubs or trees, with mostly thin shreddy bark.

* *Aments axillary: leaves ternate, free and jointed at base, linear-subulate, pungent, channelled and white-glaucous above, not glandular-pitted.* — **OXYCEDRUS.**

1. **J. communis, L.** With spreading or pendulous branches: leaves rigid, more or less spreading, 5 to 9 lines long: fruit dark blue, 3 lines in diameter or more, 1 to 3-seeded.

Var. **alpina, Gaud.** Low and decumbent or prostrate: leaves shorter, 2 to 4 lines long, and less spreading. — The species is found in the mountains from New Mexico and northward throughout British America, while the variety has a range not quite so extensive.

* * *Aments terminal: leaves ternate (or opposite), of two forms, mostly adnate and scale-like, closely appressed and crowded upon the branches and often glandular-pitted, occasionally more distant, free and subulate.* — **SABINA.**
Ours belong to the group with bluish-black pulpy berries.

← *Leaves fringed on the edges.*

2 **J. occidentalis, Hook.** A shrub or small tree, with shreddy bark and pale reddish-yellow wood: leaves closely appressed, obtuse or acutish: berries 4 to 5 lines in diameter, with one or more seeds. — Northwest of our range.

Var. **monosperma**, Eng. Often with eccentric layers of wood, of scraggy growth, with short branchlets at right angles: leaves as often in twos as in threes: berries smaller, often copper-colored, with mostly one (sometimes 2 or more) grooved seed. — Trans. Acad. St. Louis, iii. 590. From the Pike's Peak region of Colorado to W. Texas, Arizona, and California.

+ + *Leaves entire or nearly so, and opposite.*

3. **J. Sabina**, L., var. **procumbens**, Pursh. *A prostrate shrub with appressed or slightly squarrose acute leaves in pairs, margin slightly or indistinctly denticulate: berries on short recurved peduncles, 3 to 4 lines in diameter, with 1 or 2, rarely 3 rough seeds.* — From British Columbia and the Pacific Coast to the Yellowstone River, the Great Lakes, and eastward to Maine and Hudson Bay.

4. **J. Virginiana**, L. *The largest of our Junipers, sometimes becoming a tree 60 to 90 feet high, commonly of pyramidal form, sometimes with rounded spreading top, with shreddy bark and red and aromatic heartwood: branchlets slender, 4-angled, with obtuse or acutish leaves having entire margins: berries on straight peduncles, 3 to 5 lines in diameter, with 1 or 2 angled mostly grooved seeds.* — Our widest spread species, with almost a continental distribution, the region from Arizona to Utah, California, and Oregon alone being excepted.

2. ABIES, Link. FIR.

Trees of pyramidal form and rapid growth, but with brittle and easily decaying wood: leaves on the horizontal branchlets appearing 2-ranked by a twist near the base, in ours bearing stomata on both sides, with two longitudinal resin-ducts.

1. **A. concolor**, Lindl. *A large tree 80 to 150 feet high with a diameter of 2 to 4 feet and a rough grayish bark: leaves mostly obtuse, pale green, with the two resin-ducts close to the epidermis of the lower surface: cones oblong-cylindrical, 3 to 5 inches long and 1 to 1½ inches in diameter, pale green or sometimes dull purplish; scales 12 to 15 lines wide, nearly twice wider than high.* — Has been mostly called *A. grandis*, which is much taller and has a more northwestern range. *A. amabilis* (?) Watson, Bot. King Exped. *Pinus concolor*, Eng. From Arizona and S. Colorado to Utah and California. Known as "White Fir" on account of its gray bark.

2. **A. subalpina**, Eng. *Not so tall, 60 to 80 feet high, with very pale, and thin, smooth, or only in very old trees cracked, and ashy-gray bark: leaves dark green above, sharp-pointed, with the two resin-ducts about equidistant from upper and lower surface: cones oblong-cylindrical, 2½ to 3 inches long and 1 to 1½ inches in diameter, purplish brown; scales nearly orbicular or sometimes quadrangular, 6 to 10 lines long and broad.* — Am. Nat. x. 555. *A. grandis*, in part, of the Rocky Mountain botanists. On the higher mountains and near to timber line, from Colorado northwestward to Oregon.

3. PSEUDOTSUGA, Carr. DOUGLAS SPRUCE.

A very large tree, at first pyramidal and spruce-like, often at last more spreading: leaves somewhat 2-ranked by a twist at the base, with stomata

only on the lower surface, close to the epidermis of which are the two lateral resin-ducts.

1. **P. Douglasii**, Carr. A large tree, 150 to over 300 feet high, 6 to 15 feet in diameter, with very thick brown deeply fissured bark: leaves flat, linear, 8 to 12 lines or more long: cones 2 to 4 inches long, subcylindrical; bracts more or less exsert and spreading or reflexed, giving a fringed appearance to the cones: seeds triangular, on the upper side convex and reddish brown, on the lower flat and white, 3 lines long. — *Abies Douglasii*, Lindl. Throughout the Rocky Mountains and those of California, reaching its greatest proportions in Oregon.

4. PICEA, Link. SPRUCE.

Tall pyramidal trees, with white soft tough timber: leaves spirally arranged around the branchlets, or somewhat 2-ranked.

1. **P. Engelmanni**, Eng. A tall pyramidal tree, 60 to 100 feet high, with horizontal branches; bark thin, scaly, reddish or purplish-brown; branchlets pubescent: leaves 6 to 15 lines long: fertile aments 9 to 10 lines long, dark purple: cone solitary, ovate-cylindric, about 2 lines long, reddish brown; scales obovate-rhombic, subtruncate or emarginate, erose. — *Abies Engelmanni*, Parry. In the mountains from New Mexico to Montana and Oregon, forming extensive forests.

2. **P. pungens**, Eng. Of strictly conical growth, with spreading branches; bark thick, smooth, and gray, in older trees becoming very thick, hard and ridged; branchlets smooth and shining: leaves 6 to 12 lines long, more pungent: fertile aments 15 to 20 lines long, with pale shining rounded scales: cones abundant, solitary or clustered, cylindrical, drooping, $2\frac{1}{2}$ to 5 inches long, light brown; scales oval or subrhombic, more or less elongated above, undulate and retuse. — The form in the Rocky Mountains heretofore called *Abies Menziesii*, which latter has a much more northwestward range and now bears the name *Picea Sitchensis*, Carr. Commonly called "Balsam."

• 5. PINUS, Tourn., Link. PINE.

Trees, usually not so large as in the preceding genera, nor often of such pyramidal habit, with wood of the greatest value: primary leaves (only on seedlings and young shoots) flat, subulate and serrulate; the secondary in bundles, needle-shaped, terete, semiterete, or triangular, depending on the number in a bundle.

§ 1. Scales slightly if at all thickened at the end and wholly destitute of prickle or point: leaves in fives, with resin-ducts close to the epidermis, their sheaths loose and deciduous: cones subterminal. — STROBUS. In ours the leaves are entire or nearly so, and the cones sessile.

1. **P. flexilis**, James. A tree about 60 feet high and 3 to 5 feet thick, with furrowed gray bark: leaves $1\frac{1}{2}$ to 2 inches long: cones oval to subcylindric, 3 to 5 inches long, light brown, with somewhat squarrose scales. — Long's Exped. ii. 27. In the mountains from New Mexico to Montana and westward.

Var. **albicaulis**, Eng. A tree 40 or 50 feet high, becoming low and shrubby at the highest elevations, with very pale bark: cones oval or subglobose, $1\frac{1}{2}$ to 3 inches long, $1\frac{1}{2}$ to $2\frac{1}{4}$ inches thick, purple brown; scales much thicker and somewhat pointed. — Bot. Calif. ii 124. *P. albicaulis*, Eng. On alpine peaks in Montana, extending from the mountainous regions of California to British Columbia.

§ 2. *The woody scales thickened at the end, and usually spiny-tipped (sometimes blunt-pointed).* — PINASTER.

* *Resin-ducts close to the epidermis: leaves with entire margins and loose deciduous sheaths.*

2. **P. edulis**, Eng. A low round-topped tree, branched from the base or near it, 10 to 15 feet high: leaves mostly in pairs (rarely in threes), 1 to $1\frac{1}{2}$ inches long, rigid, curved or straightish, spreading: cones sessile, subglobose, 2 inches long; tips of scales thick, truncate, raised-pyramidal but without awns or prickles: seeds brown, wingless, edible. — From S. Colorado and southward. The "Piñon" or "Nut Pine" of the Indians. Westward it is replaced by *P. monophylla*, Torr. & Frem.

3. **P. Balfouriana**, Jeffrey. A medium-sized tree, seldom over 50 feet high and sometimes 5 feet in diameter, of regular pyramidal growth: bark red-brown, deeply fissured: leaves in fives, 1 to $1\frac{1}{2}$ inches long, rigid, curved, crowded and appressed to the stem: cones pendulous from the slender branchlets, subcylindrical, $3\frac{1}{2}$ to 5 inches long, dark purple; tips of scales thick, with short deciduous prickles: seeds pale, mottled, and winged. — West of our range.

Var. **aristata**, Eng. Tree 50 to 100 feet high: cones ovate, with thinner scales, and with shorter recurved or slender awn-like prickles: seeds smaller and wings shorter. — Bot. Calif. ii. 125. *P. aristata*, Eng. From Colorado through Nevada and Arizona to California.

* * *Resin-ducts within the cellular tissue: leaves serrulate and with persistent sheaths: cones subterminal.*

4. **P. ponderosa**, Dougl. One of the largest pines (200 to 300 feet high and 12 to 15 feet thick), with very thick red-brown bark, deeply furrowed and split in large plates: leaves in threes, 5 to 11 inches long: cones oval, 3 to 5 inches long, $1\frac{1}{2}$ to 2 inches thick, of a rich brown color, sessile or nearly so, often 3 to 5 together; tip of scales with a stout straight or incurved prickle: seeds dark brown, 4 lines long; wings 10 to 12 lines long, widest above the middle. — The most magnificent and widely spread Western pine. Known as the "Yellow Pine." The following form is found throughout the Rocky Mountains.

Var. **scopulorum**, Eng. A smaller tree (80 to 100 feet high): leaves 3 to 6 inches long, often in pairs: cones smaller, 2 or 3 inches long, grayish brown, with stout prickles: seeds $2\frac{1}{2}$ to $3\frac{1}{2}$ lines long. — Bot. Calif. ii. 126. Most of the *P. ponderosa* of the Rocky Mountains is of this variety.

5. **P. contorta**, Dougl. A low tree, 5 to 15 or rarely 25 feet high and 6 inches in diameter, with a rounded or depressed top and thin smoothish bark: leaves in pairs, 1 to $1\frac{1}{2}$ inches long: cones clustered, oval or subcylindric, very oblique; tip of scales with strong knobs and delicate prickles: seeds black, grooved, 2 lines long; wings 6 lines long, widest above the base and tapering upward. — A Pacific Coast species from California to Alaska.

Var. **Murrayana**, Eng. Much taller and straighter, 80 to 120 feet high and 4 to 6 feet in diameter, with a conical head and *thin scaly light grayish-brown bark*: leaves 1 to 3 inches long, $\frac{3}{4}$ to 1 line wide, light green: cones very rarely lateral, less oblique: wings of seeds longer. — Bot. Calif. ii. 126. *P. Murrayana*, Murr. *P. montana*, var. *latifolia*, Eng. In the mountains of Colorado and Utah, and extending northward and westward.

SERIES II.

PTERIDOPHYTA (VASCULAR CRYPTOGRAMS), or FERNS AND THEIR ALLIES.

PLANTS destitute of proper flowers, that is, having no stamens and pistils, and not producing seeds. A distinct axis containing fibro-vascular bundles, as does the foliage when there is any. Sexual reproduction by means of antheridia and archegonia, one or both of which is formed on a prothallus which is developed from the non-sexual spore and upon which the conspicuous but non-sexual plant is produced.

CLASS I. LYCOPODINEÆ.

Plants with a solid, dichotomously branched, leafy stem, the leaves imbricated and often giving to the lower forms a moss-like appearance, but may be distinguished from moss leaves by their midrib. Sporangia in the axils of simple leaves or bracts.

SUBCLASS I. HETEROSPOREÆ.

Producing spores of two kinds, the larger (*macrospores*) producing a prothallus with archegonia, the smaller (*microspores*) producing a prothallus (rudimentary) with sperm-cells. Leaves with ligules.

ORDER 91. ISOËTÆ. (QUILLWORT FAMILY.)

Mostly aquatic plants, with a short solid corn-like stem (*trunk*) and elongated grass-like leaves, the bases of which are expanded and have thin stipule-like infolded margins (the *velum*), which enclose large simple ovoid thin-walled sporangia; the outer ones containing large spherical trivittate macrospores; those of the inner leaves filled with very minute grayish triangular microspores.

1. ISOËTES, L. QUILLWORT.

Characters those of the order. For an elaboration of the genus see Engelman in Trans. St. Louis Acad. iv. 358. Our species (as reported at present) belong to the group with bilobed trunks, are all submerged, with quadrangular leaves and an incomplete velum.

1. *I. lacustris*, L. Leaves stout, rather rigid, acute but scarcely tapering, dark or olive-green, 10 to 25 in number, 2 to 6 inches long, with no stomata: sporangium orbicular to broadly elliptical, not spotted, with a rather narrow velum; macrospores 0.50 to 0.80 mm.¹ in diameter, marked all over with distinct or somewhat confluent crests; microspores smooth, 0.035 to 0.046 mm. in the longer diameter. — Generally distributed throughout Northern America and New England.

Var. *paupercula*, Eng. Leaves fewer (10 to 18), thinner, shorter (2 to 3 inches): spores smaller; macrospores 0.50 to 0.66 mm. in diameter; microspores somewhat granulated, 0.026 to 0.036 mm. long. — Trans. St. Louis Acad. iv. 377. Grand Lake, Middle Park, Colorado (*Engelmann*), and near Mt. Shasta, California (*Pringle*).

2. *I. echinospora*, Durieu, var. *Braunii*, Engelm. Leaves soft and tapering, green or reddish green, erect or spreading, 13 to 15 in number, 3 to 6 inches long, generally with a few stomata towards the tip: sporangium as in the last, but spotted and generally $\frac{1}{2}$ or even $\frac{3}{4}$ covered by a broad velum; macrospores 0.40 to 0.50 mm. thick, covered with broad retuse spinules, sometimes somewhat confluent and then dentate or incised at tip; microspores 0.026 to 0.030 mm. long, smooth. — Gray, Manual, 676. Lake at the head of Bear River, Uinta Mountains (*Watson*). The most common species eastward, but reported only from the one station within our range. Apparently replaced with us by the following.

3. *I. Bolanderi*, Engelm. Leaves erect, soft, bright green, tapering to a fine point, 5 to 25 in number, 2 to 4 $\frac{1}{2}$ inches long, generally not many stomata: sporangium broadly oblong, mostly without spots, with a narrow velum; macrospores 0.30 to 0.40 mm. thick, marked with minute low tubercles or warts; microspores 0.026 to 0.031 mm. long, generally spinulose, rarely smooth. — Am. Nat. viii. 214. In ponds and shallow lakes in the Rocky Mountains, Sierra Nevada of California, and Cascades.

ORDER 92. SELAGINELLÆ.

Moss-like plants with slender branching stems and small leaves arranged in 4 or several ranks: sporangia minute, subglobose; some containing usually 4 globose macrospores; others (smaller and more abundant) filled with numerous microspores.

1. SELAGINELLA, Beauvois.

Characters those of the order. In ours the leaves are all alike arranged in many ranks, those of the fruiting spikes 4-ranked.

¹ The millimeter is very nearly half a line

1. **S. rupestris**, Spring. Stems prostrate or ascending, rather rigid, 2 to 12 inches long, vaguely or subpinnately branching: leaves glaucescent, closely imbricated and appressed, lanceolate, scarcely a line long, convex and grooved on the back, bristle-tipped and ciliate: spikes strongly quadrangular: macrosporangia abundant, intermixed with the slightly smaller and more numerous microsporangia. — On dry rocks, especially in the mountains.

SUBCLASS II. ISOSPOREÆ

Producing but one kind of spore. Leaves without ligules.

ORDER 93. LYCOPODIACEÆ. (CLUB-MOSS FAMILY.)

Moss-like plants, with small leaves imbricated in 4 to many rows on the pinnately or dichotomously branching stems, and (in ours) with reniform 1-celled sporangia in the axils of bracts forming stalked or sessile spikes.

1. LYCOPODIUM, L., Spring. CLUB-MOSS. GROUND-PINE.

Characters those of the order. In ours the leaves (bracts) of the spike are yellowish, ovate or heart-shaped, very different from the other leaves.

1. **L. annotinum**, L. Stems prostrate and creeping, 1 to 4 feet long; the ascending branches similar, dichotomous, 4 to 6 inches high: leaves in several ranks, equal, spreading, rigid, lanceolate, pointed, serrulate, 2 to 4 lines long: spikes solitary at the ends of leafy branches. — From Colorado to Washington, eastward and northward across the continent.

CLASS II. FILICINÆ.

Plants with a solid stem, which (in ours) is horizontal and usually underground, bearing broadly expanded mostly long-petioled leaves (*fronds*), with prominent midrib and veins. Prothallus monœcious.

ORDER 94. RHIZOCARPEÆ. (PEPPERWORT FAMILY.)

Aquatic plants, with a horizontal stem floating upon the water or running through the mud at the bottom of shallow water: leaves circinate developed, simple or quadrifid: spores of two kinds: the fruits (*conceptacles*) borne on peduncles (in fact petioles), or sessile beneath the stem.

1. **Marsilia.** Conceptacles somewhat crustaceous, several-celled, containing both macrospores and microspores, solitary and peduncled. Leaves peltately quadrifoliate, with elongated petioles.
2. **Azolla.** Conceptacles very soft and thin-walled, one-celled, containing either macrosporangia with solitary macrospores or microsporangia with numerous microspores, in pairs beneath the pinnately branched stems. Leaves minute, imbricated, and 2-lobed, apparently distichous.

1. MARSILIA, L.

Conceptacles ovoid or bean-shaped, composed of 2 vertical valves and several transverse compartments in each valve; their peduncles rising either from the petiole or the rhizome. — Plants with slender creeping rootstocks, growing in the mud under shallow water, with the leaves floating, or sometimes terrestrial.

1. **M. vestita**, Hook. & Grev. Leaflets broadly cuneate, usually hairy, entire, 2 to 7 lines long and broad; petioles 1 to 4 inches long; peduncles free from the petiole: sporocarps short-peduncled, about 2 lines long, very hairy when young. — From Texas to Oregon and California. In Yellowstone Park (*Coulter*).

2. AZOLLA, Lam.

Small moss-like floating plants, the pinnately branched stems covered with minute imbricated leaves and emitting rootlets on the under side: the paired conceptacles either both containing macrospores, or one of each kind; smaller conceptacles acorn-shaped, containing a single macrospore; larger conceptacles globose, and having a basal placenta which produces many pedicelled sporangia containing masses of microspores.

1. **A. Caroliniana**, Willd. Plant 4 to 12 lines broad, much branched: leaves with ovate lobes, inferior lobe reddish, superior one green with a reddish border: macrospores with a minutely granulate surface: masses of microspores glochidiate. — Floating on quiet waters, from Oregon to Arizona and eastward to the Atlantic.

ORDER 95. OPHIOGLOSSACEÆ. (ADDER'S-TONGUE FAMILY.)

Leafy plants; the leaves (*fronds*) simple or branched, erect in veneration: spores of one kind, borne in special spikes or panicles in sporangia (without an elastic ring), which are formed by groups of cells in the interior of the fruiting segments of the frond: prothallus underground, destitute of chlorophyll.

1. BOTRYCHIUM, Swartz. GRAPE-FERN. MOONWORT.

Fronds with a posterior pinnatifid or compound sterile segment and an anterior paniced fertile segment, the separate sporangia in a double row on the branches of the panicle: bud enclosed in the base of the stalk.

* *Base of the stalk which encloses the bud closed on all sides: sterile division more or less fleshy, the cells of the epidermis straight.*

+ *Sterile division usually placed at or above the middle of the plant: frond never hairy.*

1. **B. Lunaria**, L. Plant 4 to 10 inches high, *very fleshy*: sterile division sessile near the middle of the plant, oblong or ovate, once pinnatifid; pinnae or lobes semilunar from a broadly cuneate base, the sides concave, the outer margin crenate or even incised. — From Colorado (Parry) and New England northward.

2. **B. lanceolatum**, Angstr. Plant 2 to 10 inches high, *scarcely fleshy*: sterile division high up on the plant, sessile, deltoid, once or twice pinnatifid with oblique oblong-lanceolate acute segments. — From Colorado (Brandegee) to New England and in the far North.

+ + *Sterile division placed low down on the plant.*

3. **B. simplex**, Hitchcock. Plant smooth, fleshy, 2 to 6 inches high: sterile division short-petioled, varying from simple and roundish-obovate and 2 to 3 lines long, to triangular-ovate and deeply 3 to 7-lobed, or even to fully ternate with incised divisions; segments broadly obovate-cuneate or somewhat lunate: fertile division 1 to 2-pinnate. — Yellowstone Park (Parry) and California; eastward from Lake Superior to New England. Exceedingly variable, the true form thought to be most nearly represented by

Var. **compositum**, Milde. A low alpine form with the sterile segment an inch or less long, ternate, or composed of 3 ovate incised segments.

4. **B. ternatum**, Swartz. Plant sparsely hairy, fleshy, 4 to 12 inches high: sterile division long-petioled from near the base of the plant, broadly deltoid, ternate and variously decomposed; ultimate segments from roundish-reniform and subentire to ovate-lanceolate and doubly incised: fertile division 2 to 4-pinnate. — Throughout North America. Exceedingly variable, with many described varieties and synonyms.

* * *Base of stalk which encloses the bud open along one side: sterile division membranaceous, the cells of the epidermis flexuous.*

5. **B. Virginianum**, Swartz. Plant sparsely hairy, 8 to 24 inches high: sterile divisions sessile near the middle of the plant, broadly triangular, ternate; primary pinnae short-stalked, 1 to 3 times pinnatifid; secondary pinnae ovate-lanceolate; ultimate segments toothed at the ends: fertile division 2 to 4-pinnate. — From Washington to Colorado (Brandegee) and Texas, and eastward across the continent.

ORDER 96. FILICES. (TRUE FERNS.)

Leafy plants; the leaves (*fronds*) often much branched, circinate in veneration, rising from a rootstock: spores of one kind, borne on the under surface or margins of the leaves in sporangia (with an elastic ring), which are developed from a single epidermal cell (hence modified trichomes): prothallus above ground, green. — The sporangia are usu-

ally collected in little masses (fruit-dots or *sori*), which are often covered by a scale (*indusium*), which is produced by a cellular outgrowth from the frond, or by a general involucre formed from the infolded margin of the frond. — Eaton, Ferns of North America.

Tribe I. Sori round or oblong, placed on the veins or at the ends of the veins, without indusium. Stalk articulated to the rootstock. Veins free or reticulated. — **POLYPODIEÆ.**

1. **Polypodium.** Character of the tribe.

Tribe II. Sori more or less elongated, without indusium, on the back of the frond or its divisions, and usually following the veins, or only at the tips of the latter. Fronds often scaly or tomentose, or covered beneath with colored powder. — **GRAMMITIDÆ.**

2. **Notholaena.** Sori but little elongated, often of very few sporangia, placed below the tips of the veins near the margin of the lobes of the frond.

Tribe III. Sori close to the margin of the frond or its divisions, sometimes extending down the veins, covered (at least when young) by an involucre opening inward and either consisting of the margin or produced from it. — **PTERIDÆ.**

3. **Cheilanthes.** Sori minute, at the ends of the unconnected veins, covered by a usually interrupted involucre. — Small ferns, often woolly, chaffy, or pulverulent.

4. **Pellaea.** Sori near the ends of the veins, often confluent. Involucre membranaceous, continuous round the pinnules. Sterile and fertile fronds much alike and smooth; the stalk dark-colored.

5. **Cryptogramme.** Sori extending down the free veins. Involucre very broad, at length flattened out and exposing the now confluent sori. Sterile and fertile fronds unlike, smooth; the stalk light-colored.

6. **Pteris.** Sporangia borne on a continuous vein-like marginal receptacle, which connects the ends of the veins. Involucre continuous round the pinnules. Stalk light-colored.

7. **Adiantum.** Sporangia borne at the ends of the veins, on the under side of the reflexed margin of the frond. Midvein of the pinnules mostly eccentric or dissipated into forking veinlets. Stalk dark-colored.

Tribe IV. Sori more or less elongated, borne on veins oblique to the midvein, covered by a usually flattened indusium, which is attached to the fertile veinlet by one edge and free at the other. — **ASPLENIDÆ.**

8. **Asplenium.** Sori on the upper side of the fertile veinlet, less commonly on both sides of it. Veins free.

Tribe V. Sori round or roundish, on the back or sometimes at the tip of the fertile veinlets, naked or with an indusium. Stalk not articulated to the rootstock. — **ASPIDIÆ.**

9. **Phegopteris.** Sori dot-like, minute, borne on the back of the fruiting veinlets; indusium none.

10. **Aspidium.** Sori round, borne on the back or at the apex of the veinlets; indusium orbicular or round-reniform. — Mostly large ferns.

11. **Cystopteris.** Indusium convex, delicate, fixed across the back of the veinlet by a broad base, usually turned back by the ripening sporangia. — Delicate ferns with small fronds.

12. **Woodsia.** Indusium placed beneath the sorus, and partly or wholly enclosing it, divided into irregular lobes or into a delicate fringe. — Fronds small.

1. POLYPODIUM, L. POLYPODY.

In ours the veins are uniformly free.

1. **P. vulgare, L.** Fronds evergreen, subcoriaceous, 2 to 10 inches long, ovate-oblong to oblong-linear, pinnatifid into linear-oblong obtuse or acute

segments, the lowest ones rarely diminished: veins branched into 3 or 4 veinlets, the lowest ones on the upper side of the vein bearing at their thickened ends the subglobose sori midway between the midrib and the margin of the segments. — From the Rocky Mountains eastward to the Atlantic; also westward.

2. NOTHOLÆNA, R. Brown.

In ours the fronds are 3 to 5-pinnate, and covered beneath with a white or yellow powder, the primary and secondary pinnae distinctly stalked, and the ultimate pinnules very small, oval or 2 to 3-lobed.

1. *N. Fendleri*, Kunze. Frond 2 to 5 inches long, broadly deltoid-ovate, 4 to 5-pinnate; rhachis and all its branches flexuous and zigzag, the pinnae alternate; ultimate pinnules 1 to 2 lines long. — From Colorado to Arizona and Texas. In clefts of exposed rocks.

N. DEALBATA, Kunze, reported near the eastern and southern limits of our range, very likely occurs within it. It is closely allied to *N. Fendleri*, but may be distinguished by its smaller fronds, which are triangular ovate and 3 or 4-pinnate, straight rhachis and branches, mostly opposite pinnae, and ultimate pinnules hardly a line long.

3. CHEILANTHES, Swartz. LIP-FERN.

Small ferns, with 2 to 4-pinnate fronds, and the under surface either smooth or variously covered with hair, wool, scales, or waxy powder. Ours belong to the section in which the involucre is continuous around the greater part of the margin of the very minute and bead-like ultimate segments, and the lower surface of the fronds tomentose or scaly.

* *Fronds tomentose beneath, but not scaly.*

1. *C. lanuginosa*, Nutt. Fronds 2 to 4 inches long, ovate-lanceolate, tripinnate or bipinnate with pinnatifid pinnules; ultimate segments less than a line long; upper surface scantily tomentose, the lower surface matted with jointed woolly hairs; involucre herbaceous, very narrow. — From Arizona and Colorado to British America and eastward to Wisconsin and Illinois. Grows in dense tufts on dry exposed rocks.

2. *C. Eatonii*, Baker. Stalks with narrow scales as well as hairs: fronds 4 to 9 inches long, oblong-lanceolate, above woolly-pubescent, beneath matted-tomentose and partly scaly, tripinnate; ultimate segments $\frac{1}{2}$ line long, rounded obovate; margin continuously recurved, the edge membranaceous. — Colorado and Arizona to Texas.

* * *Fronds very scaly beneath, tomentum scanty or none.*

3. *C. Fendleri*, Hook. Rootstock slender; its scales loose and nerveless: frond 3 to 6 inches long, tripinnate; ultimate pinnules rounded and entire or obovate and 2 to 3-lobed, covered beneath with broadly ovate, acuminate scales, which are sometimes sparingly ciliate at base. — From Colorado to Arizona and Texas. In crevices of rocks.

4. PELLÆA, Link. CLIFF-BRAKE.

Allied to *Cheilanthes*, from which it differs chiefly in the continuous involucre and smooth fronds (without tomentum or scales).

* *Fronds herbaceous or sub-coriaceous; veins clearly visible; involucre broad and usually covering the sporangia till they are fully ripe.*

1. **P. Breweri**, Eaton. *Rootstock short, densely covered with narrow fulvous chaff; fronds membranaceous, 2 to 6 inches long, simply pinnate with mostly unequally 2-lobed pinnae.* — Proc. Am. Acad. vi. 555. From Colorado to Utah and California. In clefts of rocks.

2. **P. gracilis**, Hook. *Rootstock very slender, creeping, nearly naked; fronds very delicate, 2 to 4 inches long, oblong-ovate, pinnate with a few once or twice pinnatifid pinnae; segments oblong or obovate; involucre broad and delicate.* — From Colorado northward, eastward through British America, and southward again into Iowa, Pennsylvania, etc. Crevices of damp and shaded limestone rocks.

** *Fronds subcoriaceous or coriaceous; veins rather obscure; involucre conspicuous.*

+ *Pinnules obtuse, at least not mucronate; fronds 1 to 2-pinnate.*

3. **P. atropurpurea**, Fée. *Frond 6 to 12 inches long, evergreen, nearly smooth, ovate-lanceolate, usually bipinnate below, simpler upwards; pinnules oval to linear-oblong, $\frac{1}{2}$ to 2 inches long.* — From Arizona and Alabama northward to British America and Canada. Crevices of shaded limestone rocks.

+ + *Pinnules decidedly acute or mucronate.*

4. **P. Wrightiana**, Hook. *Fronds 4 to 8 inches long, lanceolate to triangular-ovate, bipinnate; pinnae longer than broad, having 3 to 13 oval or oblong-oval pinnules, fertile ones with the margins rolled in to the midvein.* — From Colorado and Arizona to W. Texas. Mostly in exposed rocky places, especially in cañons.

5. **P. densa**, Hook. *Fronds $1\frac{1}{2}$ to 2 inches long, ovate, closely tripinnate; ultimate segments linear, 3 to 6 lines long, sessile, sterile ones serrated.* — In California and Oregon; also at Jackson's Lake, Wyoming (Coulter). Clefts of rocks.

5. CRYPTOGRAMME, R. Brown. ROCK-BRAKE.

Fronds rather small, and smooth, 2 to 4-pinnate, the fertile ones taller than the sterile: stalks stramineous and tufted on a short rootstock.

1. **C. acrostichoides**, R. Br. *Fronds 2 to 4 inches long, chartaceous, ovate, closely 2 to 4-pinnate; pinnules ovate or obovate, adnate-decurrent, those of the fertile fronds narrower and longer, the involucre very broad: sori extending far down the veinlets.* — *Allosorus acrostichoides*, Spreng. From California, Colorado, and Lake Superior, northward to Arctic America. In dense patches among rocks.

6. PTERIS, L. BRACKEN.

In ours the rootstock is cord-like, and the fronds scattered, ternate, with decomposed divisions.

1. *P. aquilina*, L. Frond often very large, subcoriaceous, broadly triangular, primary divisions stalked; pinnae mostly pinnately lobed with several to many rather short obtuse lobes, and with a sometimes very long subentire apex. — Common everywhere, being the most widely distributed of ferns.

7. ADIANTUM, L. MAIDENHAIR.

Stalk mostly blackened or very dark purplish-brown and commonly highly polished.

1. *A. Capillus-Veneris*, L. Fronds pyramidal, with the rhachis continuous to the terminal pinnule, 9 to 18 inches long, often pendent, ovate or ovate-lanceolate, 2 to 3-pinnate at base; pinnules wedge-obovate or rhomboid, $\frac{1}{2}$ to 1 inch long, deeply and irregularly incised, smooth; involucre lunulate or transversely oblong. — From S. California to Utah, Arizona, Texas, and eastward to Virginia and Florida. In moist rocky places, especially about springs and along water-courses.

2. *A. pedatum*, L. Frond often a foot broad; stalk forked at the top, the branches recurved, and bearing several pinnate divisions on the upper side; primary divisions 6 to 14, bearing numerous oblong or triangular-oblong pinnules, which have the lower margin entire and the upper more or less lobed; involucre oblong-lunate or transversely linear. — Across the continent and far northward, but apparently unreported as yet from our immediate range. In rich moist woods, especially among rocks.

8. ASPLENIUM, L. SPLEENWORT.

Fronds varying from simple to highly decomposed.

* *Indusium* straight or nearly so, attached to the upper side of the vein, rarely double.

+ Fronds once pinnate, the pinnae numerous and sometimes toothed but not again divided, somewhat rigid: rhachis dark and often polished.

1. *A. Trichomanes*, L. Fronds usually 4 to 6 inches long, narrowly linear, pinnate; pinnae subsessile, roundish-oval or oval-oblong from an obtusely cuneate or truncate base, entire or crenulate, rarely incised, falling separately from the persistent rhachis. — Common throughout the United States and northward into British America. Crevices of shaded rocks.

2. *A. ebeneum*, Ait. Fronds 9 to 18 inches high, linear-oblancoolate, pinnate; pinnae 6 to 18 lines long, firmly membranaceous, mostly alternate, sessile, spreading, oblong or oblong-linear, somewhat auricled, crenately serrate or incised: sori near the midvein. — Greenhorn Mountains, Colorado (*Greene*), Indian Territory, and eastward to Canada and Florida.

+ + *Fronde more than once pinnate or pinnatifid.*

3. **A. septentrionale**, Hoffm. Fronds 3 to 6 inches high, subcoriaceous, the stalk alternately forked; branches widening into a few (2 to 5) very narrowly cuneate and acuminate entire or sparingly toothed segments: veins closely parallel and forking: sori elongated, 1 to 3 to a segment. — Colorado and New Mexico. In crevices of rocks.

* * *Indusia variously curved, often crossing the fertile veinlet and continued a short distance down the other side of it.*

4. **A. Filix-fœmina**, Bernh. Fronds 1 to 3 feet long, softly membranaceous, oblong-lanceolate, 2 to 3-pinnate; pinnules adnate to the secondary rhachis, ovate to elongated-lanceolate, variously toothed or incised: indusia lacerate-ciliate. — Common almost everywhere.

9. PHEGopteris, Fée.

Sori on the back of the veins below their attenuated apices. Differs from *Aspidium* only in having no indusium. In our species the fronds are triangular, ternate, the primary divisions stalked, and the rhachis is not winged.

1. **P. Dryopteris**, Fée. *Fronds smooth and thin, 4 to 10 inches wide and long; lateral divisions divergent; all triangular and pinnate, the pinnæ pinnatifid into oblong, obtuse, entire or even pinnately lobed segments; lowest inferior pinna of the lateral divisions equal to the second pinna of the middle division.* — From the mountains of Colorado to Oregon, eastward through the Northern United States, and far northward. Open rocky woods.

2. **P. calcarea**, Fée. *Fronds minutely glandular and somewhat rigid, 4 to 8 inches wide and long; lateral divisions ascending; all triangular and pinnate, the pinnæ pinnatifid into oblong obtuse or even pinnately-lobed segments; lowest inferior pinna of the lateral divisions equal to the third pinna of the middle division.* — Collected in Minnesota (Miss Cathcart), but, according to Professor Eaton, to be expected from Lake Superior to Idaho.

10. ASPIDIUM, Swartz. SHIELD FERN. WOOD FERN.

The round indusia attached to the middle of the sorus by a short central stalk, or roundish-reniform and attached at the base of the sinus.

* *Indusium roundish-reniform or orbicular with a narrow sinus: in ours the fronds are larger, subcoriaceous or nearly so.*

1. **A. Filix-mas**, Swartz. Fronds 1 to 3 feet long, broadly oblong-lanceolate, somewhat narrowed and twice pinnate towards the base; pinnæ lanceolate-acuminate from a broad base; pinnules or segments oblong to ovate lanceolate, obtuse or acute, toothed or incised, not glandular but sometimes slightly chaffy beneath, the upper confluent: sori near the midvein, commonly only on the lower half of each segment: stalks very chaffy with large scales. — Occurs generally throughout the continent, in several varieties. In Colorado and the Dakotas the following form has been found: —

Var. **incisum**, Mett. Differs from the type in the rhachis with scanty chaff; the pinnules or segments rather distant, lanceolate, tapering to a sub-acute point, and incised on the margin with serrated lobules. — Eaton, Ferns N. Am. i. 312.

A. SPINULOSUM, Swartz, a very widely distributed and variable species, is probably to be found within our range to the north and east. It has fronds 1 to 3 feet long, ovate to ovate oblong, fully twice pinnate and but little narrowed at base; pinnae short-stalked, the lowest ones triangular-lanceolate, upper ones gradually narrower; pinnules oblong, pinnate or pinnately incised with spinulose-serrate lobes: indusium either smooth or glandular.

* * *Indusium orbicular and entire, fixed by the depressed centre to the middle of the sorus: pinnae and pinnules often auricled on the upper side of the base.*

2. **A. Lonchitis**, Swartz. Fronds simply pinnate, 6 to 18 inches long (stalks only 1 to 3 inches), linear-lanceolate; pinnae broadly lanceolate, falcate, sharply spinulose-serrate, the lower ones symmetrically triangular and shorter, the upper ones strongly auricled. — In the Wasatch Mountains, Utah, Montana, northward to British Columbia, and eastward to the Great Lakes.

11. CYSTOPTERIS, Bernhardt.

Tufted ferns, with slender and delicate twice or thrice pinnate fronds, and cut-toothed lobes.

1. **C. fragilis**, Bernh. Fronds 6 to 12 inches long, broadly lanceolate, usually bipinnate; pinnae oblong-ovate, pointed; pinnules ovate or oblong, variously toothed or incised. — Throughout North America. Usually in crevices of shaded rocks and among stones.

12. WOODSIA, R. Brown.

Small tufted ferns growing on exposed rocks. Ours have the stalks not articulated, and the fronds glandular-pubescent or smooth, not chaffy.

1. **W. scopulina**, Eaton. Fronds 4 to 8 inches long, puberulent beneath with minute jointed hairs and stalked glands, oblong-ovate, pinnate with deeply pinnatifid pinnae, the lobes oblong-ovate and crenulate: *indusia* deeply cleft into narrow segments terminating in jointed hairs. — From Colorado westward to California and Oregon, and eastward to the Dakotas and Minnesota. In dense masses on rocks and in crevices.

2. **W. Oregana**, Eaton. Very similar, but with smooth fronds, the fertile taller than the sterile: the *indusium* reduced to a few moniliform hairs. — From Arizona and Colorado to British Columbia and Lake Superior. Habits like the last.

CLASS III. EQUISETINÆ.

Plants with a hollow, elongated, grooved or striate, and jointed stem, bearing at each node a whorl of narrow united leaves which form a close sheath. The branches, arising from the axils of these leaves, are therefore in whorls.

ORDER 97. **EQUISETACEÆ.** (HORSETAIL FAMILY.)

Stems arising from subterranean rootstocks. Sterile leaves resembling a toothed sheath at the joints; the fertile ones shield-shaped, bearing sporangia on the under side, and forming a terminal spike or cone.

1. **EQUISETUM, L.** HORSETAIL. SCOURING RUSH.

Stems simple or branched, the joints having closed ends: leaves of the fruiting cone 5 to 7-angled, and sporangia hood-like: spores round, furnished with two slender filaments attached by the middle and clavate at the free ends: prothallus above ground, green, usually diœcious.

* *Stems of two kinds; the fertile (in spring) soft, pale or brownish; the sterile appearing later, herbaceous and very different; neither surviving the winter: stomata scattered.*

1. **E. arvense, L.** Fertile stems 4 to 10 inches high, with loose and usually distant about 8 to 12-toothed sheaths, *remaining simple and soon perishing*: sterile stems slender, at length 1 to 2 feet high, 10 to 14-furrowed, producing long and simple or sparingly branched 4-angular branches; *their teeth 4.* — Across the continent, but more common eastward; also far northward. The "Common Horsetail."

2. **E. pratense, Ehrh.** *Sterile and finally also fertile stems producing simple straight 3-angled branches*: sheaths of the stem with ovate-lanceolate short teeth, *those of the branches 3 toothed*: stems more slender and branches shorter than in the last. — Colorado to Michigan and northward.

* * *Stems all alike, evergreen, mostly unbranched: fruit produced in summer: stomata in regular rows.*

+ *Stems tall and stout (1½ to 6 feet high), mostly simple, evenly 15 to 40-grooved: sheaths appressed.*

3. **E. lævigatum, Braun.** Stems 1½ to 4 feet high, sometimes with numerous branches; the *ridges convex, obtuse, smooth or minutely roughish* with minute tubercles: *sheaths elongated, with a narrow black limb and about 22 linear-awl-shaped caducous teeth, 1-keeled below.* — From Colorado to Oregon, and eastward to Illinois and Louisiana.

4. **E. robustum**, Braun. Stems 3 to 6 feet high; the *ridges narrow, rough with one line of tubercles: sheaths short*, with a black girdle above the base, rarely with a black limb, and about 40 *deciduous 3-keeled teeth with ovate-awl-shaped points*. — From British America to Mexico, and extending eastward to Louisiana and Ohio.

5. **E. hiemale**, L. Stems $1\frac{1}{2}$ to 4 feet high; the *ridges roughened by two more or less distinct lines of tubercles: sheaths elongated*, with a black girdle above the base and a black limb, of about 20 (17 to 26) *narrowly linear teeth, 1-keeled at the base and with awl-shaped deciduous points*. — In Utah and Wyoming, to British America and the Atlantic States. The "Scouring Rush," or "Shave Grass."

+ + *Stems slender, in tufts, 5 to 10-grooved, sheaths looser.*

6. **E. variegatum**, Schleicher. *Stems ascending, 6 to 18 inches long*, usually simple from a branched base, *5 to 10-grooved: sheaths green variegated with black above; the 5 to 10 teeth tipped with a deciduous bristle*. — Clear Creek, Colorado (Coulter), Utah, and Wyoming; also in the Atlantic States and northward.

7. **E. scirpoides**, Michx. *Stems very numerous in a tuft, filiform, 3 to 6 inches high, flexuous and curving, mostly 6-grooved*, with acute ridges: *sheaths 3-toothed*, the bristle-pointed teeth more persistent. — Utah and Wyoming; also in the North Atlantic States and northward.

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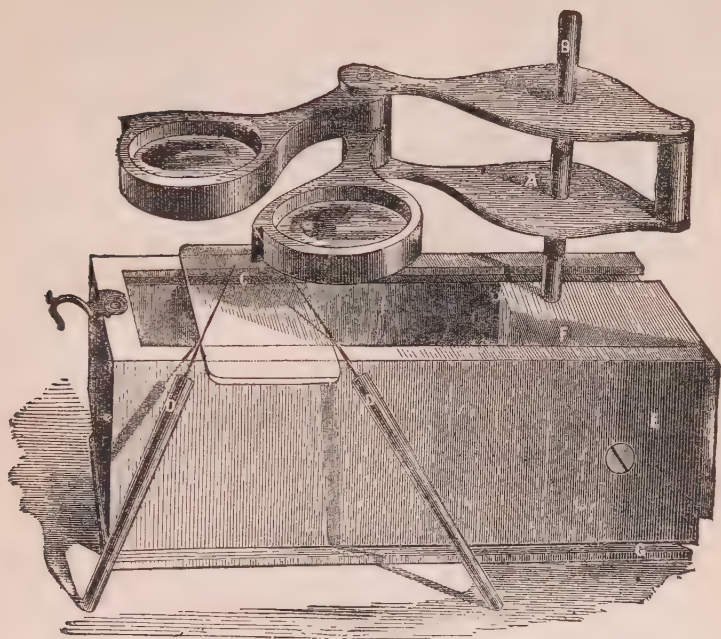
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ADDENDUM.

On page 380, after *C. frigida*, All., insert:—

28 a. *C. misandra*, R. Br. Slender, 3 to 8 inches high: leaves many, narrow, 1 to 3 inches long: sheaths purplish, leafless, usually tipped by a short setaceous bract: terminal spike pistillate above: spikes all ovate ($\frac{1}{2}$ inch or less long), dull brown, hanging on slender peduncles from a half-inch to an inch long: perigynium lanceolate, rough or serrate on the two margins, the lower half occupied by the nearly flat 3-ribbed obovate akene, longer than the obtuse brown scale.—*C. fuliginosa*, St. & Hoppe. In dense sod on Gray's Peak, Colorado (*H. N. Patterson*, 1885); also in Arctic America. (Eu.) *C. misandra* is the more recent name, but Sternberg and Hoppe applied the name *C. fuliginosa* to this species, thinking it to be the *C. fuliginosa* of Schkuhr, which is *C. frigida*, All. The species was first distinguished by Robert Brown.

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